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Without the much appreciated direction of my confrère Dr. R. E. (Dick) Rossall, who gave freely of his time to solve questions of layout, illustrations and printing, this manuscript was destined to have a longer gestation and questionable survival.

These recollections have been gathered to commemorate the contributions of friends and colleagues who brought the early technologic investigation and treatment of heart disease to Edmonton and Alberta. Without them, there would have been no story.

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Table of Contents

Introduction

The progress of medicine in the twentieth century may be seen as surges of new knowledge and plateaus of quiet accomplishment. The end of World War II marked the beginning of an exponential accumulation of information which led to undreamt-of advances in understanding disease process and applying new techniques of diagnosis and treatment.

Bob Fraser 1960

Cardiology was in the vanguard of these exciting advances and it is my hope that in this record I can describe what took place at the University Hospital between 1953, when the first cardiac catheterization marked the beginning of the new era of cardiologic diagnosis, and 1969 when I relinquished directorship of the division to Dr. Dick Rossall. There will be brief reference to the years 1922 to 1953 which led up to the current era.

For those who have joined our ranks in more recent years it may be of interest to learn something of the status of cardiology and cardiovascular surgery in those years leading to the initiation of invasive cardiology in this institution. For them, and to revive memories of my contemporaries, I have included a brief summary of the remarkable strides made in cardiology in the 15 years before 1953.

Chapter 1

In the beginning ...

The Dawn of Cardiac Surgery

At the end of World War II cardiologists were able for the first time to offer a very limited number of patients something more than palliative care and professional comfort. Penicillin, which had until then been restricted to use in the Armed Forces, became available for the treatment of infections. This dramatically changed the outlook for patients with bacterial endocarditis, an illness for which there was no cure in my student days. But the truly important changes were brought about by our surgical confrères.

Congenital Heart Disease

R. Gross and J. P. Hubbard reported the successful ligation of a patent ductus arteriosus in a seven-and-a-half-year-old girl in Boston in 1939, ushering in a decade of surgical attempts to deal with congenital heart lesions. In November, 1944, Alfred Blalock, supported by Helen Taussig, focused the attention of pediatric cardiologists on Baltimore Hospital and John Hopkins Hospital by anastomosing the subclavian artery to the pulmonary artery in the first surgical attempt to relieve cyanosis in a patient with tetralogy of Fallot (a 14-month-old baby girl). Willis Potts in Chicago devised a direct connection between the aorta and pulmonary artery to accomplish the same purpose (September, 1946).

In London, Mr. R. C. Brock at Guy's Hospital pioneered a different approach to the same problem by relieving the obstruction to outflow from the right ventricle, using a specially designed instrument introduced through the right ventricular wall (February, 1948).

C. Crafoord and C. Nylin in Stockholm sought to relieve a congenital extracardiac obstruction and in October, 1944 successfully resected the coarcted segment of the aorta in a 12-year-old boy. Gross and Hufnagel reported a similar operation from Boston in June of the following year.

Rheumatic Valvular Heart Disease

Acquired valvular obstruction had tempted surgeons since Souttar reported a successful splitting of a stenotic mitral valve in a 15-year-old girl as long ago as 1925. Apart from sporadic adventures in this field during the twenties and thirties, no significant progress was made until Gordon Murray (1945) from Toronto, Dwight Harken and his co-workers (1948) from Boston, Charles Bailey (1948) from Philadelphia, Russell Brock (1948) from Guy's Hospital, London, H. G. Smithy (1948) from Charleston, N.C. and Edouard Gagnon (1950) from the Notre Dame Hospital, Montreal, each contributed to what proved to be successful palliative treatment of this common problem.

In 1950 Baker, Brock and Campbell were willing to write that "the results in this small series (8) are good enough to show that valvotomy is a thoroughly practical procedure and can now be recommended in suitable cases."

Treatment of aortic stenosis depended to a large extent on the development of a satisfactory dilating instrument (1952), although attempts at aortic commissurotomy had been made by Bailey and Redondo-Ramirez in 1950 through the common carotid artery by what they described as an instrument of faulty design.

The desire to see the valve on which they were operating led surgeons to use several types of endoscope for this purpose. These did not prove to be sufficiently useful to discourage those who were hoping to still and open the heart using cardiopulmonary by-pass (John Gibbon), or others who were determined to reduce metabolism by hypothermia thereby permitting exploration of the heart and providing sufficient time to correct defects (Wilfred Bigelow,[1] Toronto; F. John Lewis, Minneapolis; H. Swan, Denver).

Cardiopulmonary by-pass was attempted in 1952 by John Gibbon in Philadelphia when he operated on a 15-month-old baby with a mistaken diagnosis of an atrial septal defect. There was a ductus instead and the baby did not survive. During the next year one of four further attempts was successful and he became the first surgeon to report the survival of a patient supported during a cardiac operation by a mechanical oxygenator.

F. John Lewis at the University of Minnesota Hospitals closed an atrial septal defect in a child in September, 1952, using Bigelow's technique of hypothermia, thereby becoming the first surgeon to report the survival of a patient treated in

1 Dr. John Callaghan was a co-author with Dr. Bigelow of the early papers on hypothermia.

this manner. Henry Swan soon followed with reports of relief of aortic stenosis and pulmonary stenosis using general hypothermia.

During the early development of the mechanical heart, a number of problems were encountered: clotting, hemolysis, contamination, and uncontrollable oozing. These were reported by Dodrill at the Annual Meeting of the American Medical Association, June 3, 1953. Carefully selected patients in whom the lesion was restricted to either the right or left side of the heart had been successfully operated on by Dodrill in 1952 using a pump to circulate blood around the excluded part of the circulation.

The search for methods through which the interior of the heart could be exposed for the surgeon went on with great intensity during the early fifties.

Cross-Circulation

C. Walton Lillehei, at the University of Minnesota Hospitals, pursued a different approach than that of his confrère, John Lewis. He developed a technique for controlled cross-circulation which proved suitable for children for whom a parent could act as a donor, with a Sigma motor pump interposed to maintain circulation in the recipient. In 1955 he and his colleagues, Cohen, Warden and Varco reported on 32 operations done since March, 1954, all involving open cardiotomy. Morley Cohen, a Canadian, later returned to practice cardiovascular surgery in Winnipeg. The surgical mortality was 37 percent but in the 63 percent who survived were patients with complete repair of tetralogy of Fallot, repair of ventricular septal defects, and a A-V commune lesion. When the first 10 of these cases were reported at the meeting of the American Surgeon Association in Philadelphia, April 27, 1955, Dr. Alfred Blalock said in discussion, "I must say I never thought I would live to see the day when this type of operative procedure could be performed." He went on to prophesy that "the ultimate answer will be the artificial heart lung as developed by our President, Dr. Gibbon."

Cardiac Surgery in Edmonton, 1946-1953

The only person of whom we have record performing cardiac surgery at the University Hospital during these years was Dr. W. Carleton Whiteside. Dr. Colin Dafoe received a temporary courtesy appointment to the hospital staff in April, 1951 and an "outdoor appointment" in February, 1952, but does not

appear to have done any cardiac surgery up to the middle of 1953.[2] Until 1953, the only cardiac operation of record other than those done by Dr. Whiteside was a pericardectomy for calcified constrictive pericarditis in a 28-year-old woman, a patient of Dr. Frank Elliott. She was operated on by Dr. Herbert Meltzer. Like most practitioners of those times, Dr. Meltzer and Dr. Whiteside held staff appointments at more than one city hospital.

Dr. Herbert Meltzer

Dr. Meltzer, a thoracic surgeon, later practised mainly at the Charles Camsell Hospital, which after the war was for many years the centre for treatment of native people, many of whom required surgery for pulmonary diseases.

Dr. W. Carleton Whiteside

Dr. Whiteside, a self-confident and strongly opinionated pioneer contributor to the development of cardiac surgery in Alberta, graduated from the Faculty of Medicine of the University of Alberta in 1928 with 17 classmates in the fourth graduating class of this faculty. His formal post-graduate training was scanty. In his autobiographical sketch published in 1950 (*The Nomadic Life of a Surgeon*), he recorded an internship at the Moses Taylor Hospital in Scranton, Pennsylvania for 18 months and a total of 12 months of "externship" at the University of Alberta Hospital and the Royal Alexandra Hospital in Edmonton.

He then spent a year visiting and observing surgeons in London, Edinburgh, Paris and Vienna before returning to Edmonton in December, 1931 to begin five years of general practice.

His journey back to North America was made as a surgeon on the motor yacht accompanying Sir Thomas Lipton's sailing ship, *The Shamrock* which crossed the Atlantic to compete unsuccessfully for the last time for the America's Cup. His medical contribution to the trip consisted of doing an appendectomy after the transfer of a sick seaman between *The Shamrock* and the motor yacht, *Erin*. The anaesthetist was a lawyer and the assistant the Captain.

After obtaining his Fellowship in Surgery from the Canadian Royal College (he also passed his American Boards)

2 An outdoor appointment permitted the holder to treat private and semi-private patients only. Special permission from the Chief of Service could be requested to treat paying public patients.

he restricted himself to general surgery, including thoracic operations from 1936 until 1946, when he resumed practice in Edmonton after discharge from the Royal Canadian Army Medical Corps in which he served from 1941 to 1945, attaining the rank of Major. He wrote that he "commenced specializing in thoracic surgery only on January 1, 1946."

He received an appointment to the medical staff of the University Hospital in 1932 and, in addition, held appointments at the Royal Alexandra, the General and the Misericordia Hospitals as a thoracic surgeon. As consulting surgeon to the Provincial Cancer Clinic, to which he was appointed in 1941, he had an opportunity to see most if not all the patients with pulmonary lesions and, some of his confrères thought, was in a position to unduly benefit from referrals for subsequent surgery.

Dr. Whiteside was attracted to the new challenge of cardiac surgery and in the spring of 1946 visited Ann Arbor, Michigan and Detroit after which he reported to a meeting of the Academy of Medicine in Edmonton on the status of the developing field of cardiovascular surgery with particular comments on pericardectomy, ligation of patent ductus, repair of coarctation of the aorta and the Blalock-Taussig operation.

In May and June of 1947 he travelled again, this time to England and Sweden and recorded his admiration for the medical facilities in the latter country and his respect for Crafoord's skill as a cardiovascular surgeon.

A search of the medical records of the University Hospital for all patients seen by Dr. Whiteside between January 1, 1946 and August 1, 1953 revealed the type of surgical practice he had at this hospital. As surgeon to the Cancer Clinic and thoracic surgeon to the Department of Veterans Affairs (which was responsible for the care of Veterans in the Mewburn Pavilion of the University Hospital), Dr. Whiteside did a large number of endoscopies, mainly bronchoscopies. The greater proportion of his major surgery consisted of resection of bronchogenic carcinoma and bronchiectatic lung, although he did some esophageal and breast surgery.

Although Dr. Whiteside accepted self-referred patients in his private practice it is unlikely that patients with heart disease reached him that way. In those times patients were much less well-informed about medical matters than they have become in recent years. In all likelihood the family physician or even the internist taking care of a patient with congenital heart disease would not have identified a specific diagnosis for the patient, and there would have been little demand from the patient to seek surgical treatment. The source of patients who

were operated on by Dr. Whiteside in those early years appears to have been the internists and pediatricians at the University and other hospitals although in the early years of cardiac surgery many physicians still believed that the heart was too delicate an organ to be tampered with by a surgeon. Dr. John Scott, Professor and Head of Medicine, after reading an article in the *New England Journal* (I believe it must have been Dwight Harken's description of mitral commissurotomy in 1948) expressed his disapproval of surgeons who would meddle in such medical matters!

While he and Dr. Herbert Meltzer were the only two thoracic surgeons working at the University Hospital, Dr. Whiteside proposed the establishment of a Department of Thoracic Surgery. This was discussed "at great length" according to the minutes of the meetings of the Medical Advisory Board of the University Hospital in February and March, 1950. The Director of Surgery[3] recommended that "no action be taken" – a quite common solution to troublesome requests as evidenced by the minutes of those days.

In his monograph *The First Fifty Years* in which he described the development of the University Hospital between 1914 and 1964, Dr. Angus McGugan, former Superintendent (1942-1960), referred to the subsequent formation of a Division of Cardiac Surgery in 1955 under the direction of Dr. John Callaghan. He commented that thoracic surgery "had been recognized as a specialty of the Department of Surgery for several years." There did not appear to be any evidence, however, in the records I examined that Dr. Whiteside's earlier petition had been successful in formally initiating a Department of Thoracic Surgery.

In August, 1956 Dr. Whiteside moved to Victoria. He was an individualist and had neither taken a partner in his practice nor had he seemed to enjoy the introduction into the University Hospital of a team-approach to investigation and treatment in cardiology. When Dr. Callaghan was appointed to the staff of the University Hospital in 1955, Dr. Whiteside seemed to become even more uncomfortable with the changes which were occurring and he probably sensed that there was little possibility of developing a second open-heart surgical unit at the Royal Alexandra Hospital where he was by then doing most of his surgery.

In Victoria, where he had hoped to establish an open-heart surgical unit, there was apparently insufficient support,

3 Dr. W. C. MacKenzie succeeded Dr. H. H. Hepburn (1949-1951) as Head of the Department of Surgery in September, 1951.

both financially and professionally, for this to be done. Furthermore, Vancouver was providing such care through the unit which had been established at the Vancouver General Hospital. He continued to practice thoracic and cardiac surgery and was joined in Victoria in 1960 by his old confrère, Dr. Charles Rich.

Moments after he stood up to comment on a paper at the annual meeting of the Royal College of Physicians and Surgeons in Ottawa on January 19, 1967, Dr. Whiteside suffered a cardiac arrest and despite immediate resuscitative measures he did not survive after his admission to hospital.

His self-confidence and determination enabled this man to forge ahead in the unexplored field of cardiac surgery in Edmonton in the late 1940s and he deserves to be considered a pioneer in his chosen subspeciality.

Early Case Histories

A list was made of early cardiac surgery by examining records in the University of Alberta Hospital of patients admitted to Dr. Whiteside or seen in consultation by him between 1946 and 1954.[4] With the kind permission of Dr. Whiteside's son, Dr. Carl Whiteside of Victoria, I was able later to obtain ring-binders containing all Dr. Whiteside's collected operative reports between 1946 and 1954, not only from the University Hospital but also from the other three city hospitals.

The first patient to be operated on at the University Hospital was a 16-year-old girl, a patient of Dr. Walter Scott (an internist), who had a ductus ligated with two #3 silk sutures on September 22, 1948 by Dr. Whiteside, assisted by Drs. Osborne and Wilson. Sodium morrhuate, a sclerosing solution, was "instilled about the area" of the ductus to encourage permanent closure of the vessel, but at an admission two years later she was found to have a continuous murmur suggestive of recanalization. No further admissions and no other investigations appeared in the records. Dr. Whiteside usually noted only in his operative reports when any procedure was the first to be done in the city. The absence of such comment in this report suggests that he probably ligated ductuses in other city hospitals on earlier occasions, although no record of such was found in his own collection of operative reports.

The first Blalock operation for tetralogy of Fallot done at the University Hospital was on a 16-year-old boy with severe cyanosis. Dr. Whiteside concluded his operative note of April

4 I am indebted to Miss B. Schultz, former research record librarian at the University of Alberta Hospital for her enthusiastic help in this project.

28, 1949 with a characteristic comment reading, "for historic purposes this is the first Blalock operation performed at the University Hospital, there being four others done in the city previously by me." This note in its typed form had read "done in the city previously by the same man" but Dr. Whiteside had penned in a more personal identification in the edited version.

This young man was improved by the operation until 12 years later when he presented with heart failure and the nephrotic syndrome. He died two weeks after a complete repair done by Dr. Callaghan, using cardiopulmonary bypass in May, 1962. His course following this second operation had been complicated by an infarction at the site of the right ventriculotomy followed by a delayed hemorrhage from the same site. The Blalock anastomosis was occluded by old organized thrombus and the kidneys showed the presence of giant glomeruli, an unusual finding sometimes reported in association with tetralogy of Fallot.

Despite Dr. Whiteside's assertion that this was the fifth Blalock operation he had done in Edmonton, I was able to find operative reports on only two others and presumptive evidence for a third. A nine-year-old girl had a left Blalock shunt established on January 29, 1949 at the Royal Alexandra Hospital (Dr. Neil Cutherbertson first assistant). On August 16, 1948, at the same hospital (Dr. Leslie Willox first assistant), a boy of uncertain age had what may have been the first such operation in the city and province. The third patient of which there is record was a 21-year-old young lady,[5] also operated on at the Royal Alexandra Hospital in 1949.

The collected operative reports of Dr. Whiteside for 1949 showed that he had ligated two ductuses, one at the Royal Alexandra Hospital and the other at the University Hospital. He did a second Blalock shunt at the University Hospital and two more at the Royal Alexandra Hospital. He also described an exploratory thoracotomy on an 18-year-old girl in whom he unsuccessfully searched for a ductus, suspected because of basal systolic and diastolic thrills – and clinical cyanosis.

There appear to have been only four cardiac operations in 1950: a Blalock and a Pott's operation at the Royal Alexandra Hospital; a mitral split at the University Hospital; and an unsuccessful attempt to do a second Blalock anastomosis at the University Hospital on a 21-year-old woman who had her first operation at the Royal Alexandra Hospital in 1949. She died in the operating room, having developed cardiac arrest shortly after her chest was opened.

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5 Eighteen years later at age 39 she had a successful complete repair by Dr. Callaghan.

In 1951 no operations were recorded at the University Hospital although he operated on a patient at the Misericordia Hospital (Dr. Neil Cutherbertson assistant) for coarctation of the aorta[6] and tied two ductuses at the Royal Alexandra Hospital. In the same hospital he did what was probably the first mitral split in the city. The patient was a 39-year-old man who died a week after operation from cerebral emboli.

In 1952 Dr. Whiteside operated on his second patient with coarctation of the aorta, the first to be attempted at the University Hospital (Dr. Bellamy assisting). As he had done with the first case, he anastomosed the left subclavian artery to the aorta, distal to the coarctation. This year saw an increase in cardiac operations. Five patients with mitral stenosis were operated on, two at each of the University and Misericordia Hospitals and one at the Royal Alexandra Hospital; a ductus was ligated at the University Hospital; an exploratory thoracotomy at the same institution resulted in the operative death of a young woman with primary pulmonary hypertension and a second operation at the Royal Alexandra Hospital on a girl with an ineffective Blalock shunt resulted in a change in the diagnosis from the original one of tetralogy to a Taussig-Bing form of transposition of the great vessels. She survived the exploratory operation and in 1957 Dr. Callaghan carried out a Mustard operation.

From January to the end of August 1953 the pace quickened. Ten of the 12 operations which appear in the records were done at the University Hospital and one each at the Royal Alexandra and Misericordia Hospitals.

Seven were operations on the mitral valve. Two of the seven valves proved to be unsuitable for splitting. One patient had atrial thrombi and associated aortic valvular disease; the other had predominant mitral regurgitation, developed heart block during operation and died nine days postoperatively.

Three ductuses were tied at the University Hospital and two stenotic pulmonary valves were enlarged with the Brock valvulotome. One of the latter was a 10-month-old infant, a patient of Dr. Lloyd Gridsale, cyanosed since birth, who was admitted in January 1953. The report of the venous angiogram illustrated a common difficulty in the days before the pressure injector and central injections. The results were "unsatisfactory as the injection has been made too slowly." At that time there was no rapid cassette changer and Dr. Copestake, the radiologist who reported the study, complained that "the first film was taken too late." Despite these shortcomings and what he described as an inad-

6 In the subsequent operative note on another patient, Dr. Whiteside claimed that this patient was the first to be operated on for this lesion "west of Toronto."

equate anesthetic he identified an overriding aorta and a ventricular septal defect. This was the extent of diagnostic help available at that time. During a subsequent admission, a Brock-type valvotomy was attempted on July 24, 1953, after which she made a slow recovery. Unfortunately she did not survive a complete repair undertaken by Dr. Callaghan in 1957 largely because of intraoperative bleeding from old adhesions. There was a marked degree of infundibular obstruction and the bicuspid pulmonary valve did not show any remaining evidence of the earlier valvotomy.

The second of the two patients with pulmonary valvular obstruction was a 7-year-old boy who had been cyanotic since two months of age. Dr. Whiteside described in his operative report the use of dilators and the Brock "punch." This boy improved and in 1967 had a complete repair of his septal defect and correction of the residual pulmonary valvular stenosis carried out by Dr. Callaghan. He was well when last seen for an unrelated problem in 1975.

During the seven years in which Dr. Whiteside did the cardiac surgery which I have recorded, he also had a busy practice in thoracic surgery. At a staff meeting at the University Hospital in May, 1953, he described the surgery he had done between January, 1947 and December, 1952. His notes listed 247 thoracotomies for treatment of diseases of the pleura, lung, esophagus, thymus and thyroid. He was an enthusiastic endoscopist and accumulated 485 bronchoscopies (of which he writes 75 percent were "positive") and 160 esophagoscopies.

Two vascular operations reflected a method used at that time to treat arterial aneurysms. Dr. Whiteside treated an aneurysm of the ascending aorta in a 72-year-old woman by inserting a length of wire into the aneurysm under local anesthesia and she survived to leave hospital. A 51-year-old man with aneurysms of the innominate and carotid arteries did not fare so well. A pulsating discoloured mass was visible medial to the right sterno-clavicular junction. **Fifty-five feet** of wire was introduced into the aneurysm in April, 1951 and he was readmitted in August for **another 84 feet**!. His postoperative blood loss was considerable and he died nine days later.

Such was the status of cardiac surgery at the University Hospital at the start of the '50s. It was apparent that development of surgical treatment of both acquired and congenital heart disease called for much more accurate diagnosis than had been attempted in the "presurgical" days. The need to establish a laboratory for invasive diagnostic cardiology was accepted by the Dean and the Hospital Administration.

Chapter 2

The Stirring of Modern Cardiology

The Origins of Invasive Cardiology

One might argue that the development of new diagnostic methods in medicine occurs because a new form of treatment has become available. In cardiology this indeed seems to have been so.

Although pathologists such as Maude Abbott had made universally recognized contributions to the classification and anatomical understanding of congenital heart disease, a comparable level of clinical understanding was reached only by those few who were interested in diagnostic problems for their own sake.

To the general internist and the practising pediatrician a diagnosis of congenital heart disease was sufficiently specific without their worrying about ways to distinguish between Eisenmenger's syndrome and transposition of the great vessels. It really did not matter, because until the development of the surgical procedures reported in the late '40s, there was no treatment.

As Dr. Paul Dudley White wrote in the third edition of his widely acclaimed monograph *Heart Disease* (1944), "There is no special therapy for congenital coarctation of the aorta, but the subject should be protected as much as possible from physical strain and infections." What a remarkable change took place as that edition came on sale!

The development of surgical treatment for a number of both acquired and congenital heart lesions called for much more specific diagnoses than had been sufficient in the past, and this in turn required the use of new invasive diagnostic measures.

If one examines the first attempts to introduce catheters into the blood vessels and heart of human beings two purposes emerge – to facilitate a new form of treatment or to obtain experimental information for those interested in human physiology.

A German physician, Fritz Bleichroder, with two colleagues, attempted to treat four women with puerperal sepsis by

injecting salvarsan (a form of arsenic) through a catheter introduced into the aortic root in 1912. Werner Forssmann, another German, in 1929 performed his amazing self-catheterization because of his interest in giving drugs rapidly in the case of emergencies in the operating room. Although he later attempted to opacify the cardiac chambers he was not successful and it remained for George Robb and Israel Steinberg in New York to introduce "A practical method of visualization of the chambers of the heart, the pulmonary circulation, and the great blood vessels in man" in 1938. By 1943 they were able to report 100 cases of cardioangiography using two injections to produce single-frame, postero-anterior and oblique views.

Andre Cournand,[7] a physician and human physiologist, introduced cardiac catheterization to clinical cardiology through his desire to measure cardiac output and to record right atrial pressure. Cournand and Ranges (1941), and Richards, Cournand, Darling and Gillespie (1941) reported on right atrial pressures in normal subjects and those with congestive failure from their work at Columbia University and the Chest Service of Bellevue Hospital in New York City.

Four years later Cournand described at a meeting of the Federated Societies the measurement of cardiac output by right heart catheterization and argued the safety of the procedure on the record of 1200 cases collected from centres in the United States and the United Kingdom.

John McMichael spoke at the same meeting and described 353 cardiac catheterizations carried out by him and his colleague Sharpey-Shafer, in wartime conditions in London, working on the open wards and using injections of sodium iodide into the catheter to opacify it for radiologic guidance.

Catheterization of the left side of the heart was pioneered by two Cubans, E. Ponsdomenechand and V. Nunez, who used a sub-xiphoid needle puncture to introduce the contrast material into the left ventricle and reported the results on 30 patients in 1951. This procedure understandably did not gain popularity and it remained for Sven Seldinger to introduce percutaneous catheterization of the arteries in 1953. Various methods were devised to try to visualize the coronary arteries but it was not until 1962 that Mason Sones and Earl Shirley in Cleveland reported a practical technique for coronary arteriography.

The study of the heart by invasive methods was developed over 21 years, extending from 1941 to 1962. During the

7 The Nobel Prize in Physiology and Medicine was shared in 1956 by Werner Forssmann, Dickinson Richards, and Andre Cournand

following 25 years advances have largely resulted from technical improvements in the application of the methods developed during those amazingly productive early years. Equipment, particularly that used for imaging, has produced much improved reproductions, and the application of computer techniques has introduced objective methods of evaluation of the coronary vessels.

Cardiologists owe a debt to both the inquiring minds of the cardiopulmonary physiologists and to the persistence and courage of the pioneer cardiac surgeons for ushering them into the invasive era.

We have now entered another era in which noninvasive methods – radionuclides, positive emission tomography and magnetic resonance imaging may well replace many, if not all of the invasive diagnostic procedures.

Early Developments of Cardiology at the University Hospital

Between the end of the second world war and 1953 surgeons attempting to do cardiac surgery at the University Hospital could expect little diagnostic help from pediatricians or internists and only rather limited information from the radiologists working with venous angiograms and chest films. There were no cardiac catheterization facilities in the province.

University Hospital, ca 1953
(used with permission of Provincial Archives of Alberta)

The degree of recognition afforded cardiology in the University Hospital only a few months after Blalock and Taussig reported their history-making operation on a baby with tetralogy of Fallot can be illustrated by the action of the Medical Advisory Board at the meeting of January 8, 1945. Dr. Angus McGugan discussed the problem which had arisen as a result of the death of Dr. Charles Hurlburt,[8] who had held the position of Visiting Physician in Charge of the Cardiological Department since 1922. In considering the vacancy created by his death the Board decided "not to employ an official cardiologist." The matter appeared to revolve largely around the interpretation of electrocardiograms, and members of staff were advised to read their own tracings or request a consultation. It was also announced that the Hospital had reduced the charge of an interpretation for a repeat electrocardiogram from $5.00 to $2.50, not a bad fee for 40 years ago when one considers inflation and the current price of $8.60 (1986).

Dr. Charles Hurlburt, ca 1916

In 1953 there were 285 specialists of all kinds registered in the whole of Alberta. In internal medicine the only recognized subspecialties were dermatology and neurology. In contrast, subspecialties were practised in surgery in the fields of orthopedics, neurosurgery, urology, otolaryngology and plastic surgery. Doubtless it was easier to recognize the boundaries of a subspecialty in surgery and more difficult to segregate those in medicine who auscultated the lungs from those who used the same instrument to listen to the heart.

Following the Second World War the University Hospital and the Mewburn Pavilion, together constituting 650 beds, were served by a group of dedicated and competent internists. Dr. John Scott had succeeded Dr. Edgerton Pope as Director and Head of the Department of Medicine and had been joined after the War by Dr. Frank Elliott, a 1936 graduate of the University of Alberta who had trained in internal medicine at the Mayo Clinic before joining the Canadian Navy. Dr. Kenneth Hamilton and Dr. Donald R. Wilson, both former Rhodes Scholars, returned to Edmonton after service in the Canadian Army and Air Force respectively. Dr. Hamilton was particularly interested

8 Dr Hurlburt died aged 63, October, 1944

in the then new field of psychosomatic medicine (and the more established one of horse racing) and was Chief of Medicine in the Mewburn Pavilion which served patients of the Department of Veterans Affairs.

Dr. Wilson, after additional experience in Boston at the Massachusetts General Hospital, returned to establish a metabolic unit, the first subspecialty in medicine at the University Hospital. In 1954 he became Director and Head of Medicine, succeeding Dr. John Scott who, with his extraordinary energy and ability, had carried the double load of deanship and directorship for the previous six years.

Dr. S. M. Scott and Dr. Walter Scott (none of the three Scotts were related to the others) both practised internal medicine and had helped to carry the burden of wartime teaching. Dr. Kenneth Thomson held the distinction of being qualified in both internal medicine and psychiatry but his interests also included rheumatology and neurology. Dr. Edward (Ted) Donald, an internist with a family practice, became increasingly interested in the treatment of those with allergies.

This was the solid base of internal medicine, often with a good deal of family practice, from which grew subspecialty practices arising from special interest and indeed particular competence. It would be some time yet before "special interests" would become formally recognized as subspecialties in Canadian medicine (and somewhat later yet in Alberta) through examinations of the Royal College of Physicians and Surgeons which had the responsibility for establishing and maintaining standards of professional competence in the medical and surgical disciplines.

The surgeons led the way in expanding the range of examinations to include some surgical subspecialties in 1944 and other specialties followed.[9] It was not until the late sixties that medicine admitted the need to recognize more of the developing subspecialties and in 1970 the first examinations for specialty qualification in Cardiology were held.

Despite the conservative approach of the College in the forties, a number of graduate trainees began to search out training which would permit them to focus their practices and increase their competence in a more restricted part of the rapidly expanding field of internal medicine.

By 1953 two internists had returned to Edmonton with a special interest and added training in cardiology.

9 The Council of the Royal College agreed to modification of the examinations to recognize specialties in dermatology/syphilology, neurology and/or psychiatry, pediatrics, neurosurgery, orthopedics, urology, obstetrics and gynecology.

Dr. Gordon I. Bell

Dr. Bell is the son of a pioneer Edmonton internist and teacher, Dr. Irving Bell, M.B. (Toronto), F.R.C.P.(C), who practiced internal medicine and anesthesia and who taught therapeutics, general medicine and anesthesia at the University Hospital and the Royal Alexandra Hospital from 1922 until his death in 1953. Gordon Bell received his degree in Medicine from the University of Alberta in 1940. He joined the R.C.A.F. as a medical officer after spending two years on the house-staff of the University Hospital. During the second of these he was a resident on the service of Dr. Walter Scott (known to the students as "Woof-Woof"). Dr. Scott was an internist with an interest in cardiology and pulmonary diseases. During this time Dr. Gordon Bell adopted what became a lifelong habit of an uninterrupted mid-day rest period, initially required because he had developed pulmonary tuberculosis while a resident. He now remembers with gratitude this unusual concession of his service chiefs which permitted him to continue his training in those days when a houseman was expected to be available 24 hours a day.

While stationed in Edmonton he was given an outpatient appointment to the University Hospital. The records show that Dr. Edgerton Pope wrote the Acting Dean, Dr. J. J. Ower, who agreed to an appointment for Dr. Bell in the Department of Medicine but changed the suggested rank from Sessional Demonstrator to Honorary Assistant Sessional Demonstrator – without honorarium. In those days, when the operating budget of the Faculty of Medicine was $130,000 (1944) there was a surprising formality to those appointments at the bottom of the academic ladder, even when they cost nothing. In January, 1943 it took no less than the Board of Governors at the University of Alberta to approve the appointment.

Flight Lieutenant Bell was posted to Deer Lodge Hospital, Winnipeg, and spent from 1943 to 1945 on the service of Dr. Lennox (Buzz) Bell, later Head of Medicine and then Dean at the University of Manitoba. Dean Bell was not related to the Edmonton Bells of whom there were six – father Irving Bell and four sons: Gordon, an internist- cardiologist, Edward (Ted), a clinical pathologist, Donald, an obstetrician, and Alan, a chartered accountant, and Dr. David Bell (unrelated).

Upon Dr. Bell's return to Edmonton Dean Ower approved Dr. Scott's recommendation that Dr. Bell be appointed an Instructor in Medicine. In his letter to the President of the University, October 9, 1945, the Dean was careful to stipulate that the amount of the honorarium was "to be determined by

the amount of teaching he is able to do." How this was measured was not stated.

Dr. Bell's time spent at Deer Lodge was accepted as were a number of war time hospital postings, as approved training leading to eligibility to sit the examinations of the Royal College.

Dr. John Scott encouraged and helped many graduates of this faculty to seek further training in well-known medical centres. A letter dated May 10, 1946 from Dr. William Evans, a senior British cardiologist, was evidently in reply to one from Dr. Scott. With the customary brevity of a British correspondent it read in total, "Both Dr. Parkinson and myself would welcome Dr. Bell at the cardiac department of the London Hospital."

Supported by a Nuffield Travelling Fellowship, Dr. Bell spent a year in London (1947-1948) at the London Hospital and at the National Heart Hospital where pioneers of the invasive cardiology of the fifties and sixties were beginning their work. On returning to Edmonton he agreed to Dr. Scott's suggestion that he write the certification examinations of the Royal College in Internal Medicine which took place within a month. He successfully completed these despite the short notice and once more took up practice with his father with major clinical appointments at the Royal Alexandra and University Hospitals. The process of re-appointment to the University staff was again mirrored in letters from Dean Ower and Dr. Scott to President Robert Newton, followed by approval from the Executive Committee of the Board of Governors of the University. He had been promoted to Lecturer in Medicine, this time at $350 a year. Dr. Ower had obviously been softened up.

Gordon Bell played an active role in the Division for a number of years, taking part in the weekly rounds and in the early years contributing in an essential manner to the flow of patients for investigation when others still harboured some doubts about both the safety and the necessity of invasive investigation. Later on, in keeping with the requirements of most of the metropolitan hospitals that a practitioner have active privileges in one hospital only, he chose to confine his practice to the Royal Alexandra Hospital although he remained a teaching member of the faculty Division of Cardiology.

Dr. Joseph Dvorkin

Dr. Joseph Dvorkin was a Calgarian and was, like Gordon Bell, a graduate of the University of Alberta, obtaining his M.D. degree in September 1943 in one of the accelerated classes

of wartime. He interned at the Royal Alexandra Hospital until April 1944 when he was commissioned in the R.C.A.M.C. and was posted first to Camp Borden (Ontario) and then to London, England. After marrying and returning to Canada as a Major he was discharged and began postgraduate training at the Royal Alexandra Hospital, first in Medicine and then for a year in Pathology under Dr. Morton Hall. Dr. Hall ran both the Clinical Laboratory and the Pathology Department. With thin fingers, stained by tobacco as well as the dyes and fluids of his specialty, with a facial tic which he was quick to point out to anyone similarly affected could be overcome by will power – as he had – and with a patch of grey hair protruding over the murky lenses of his glasses, he was admirably suited to his role of a somewhat eccentric, slightly-mad pathologist.

Dr. Joseph Dvorkin

After a final year (July 1948 - June 1949) as resident in Medicine at the University Hospital, Joe left for the United States. He was one of the first group of trainees to enroll in the newly established faculty program of graduate training directed by Dr. Mark Marshall (Levy). Dean Scott and Dr. Marshall expected each person to spend at least one year at a centre with an established reputation in medical education. Joe Dvorkin was fortunate to be able to spend his year at the Mount Sinai Hospital, New York City, on the service of Dr. Arthur Master, the originator of the Master Two-step Stress Test, the first test designed to confirm the presence of myocardial ischemia with the electrocardiogram.

Although he was not on his service, Joe was lastingly influenced by Dr. Charles Friedberg, an accomplished clinician and one of the last clinical cardiologists to produce a comprehensive textbook on cardiology written by a single author. The other giants of the time were Dr. Paul Dudley White in Boston and Dr. Paul Wood in England. Another person of whom he spoke with admiration was Dr. Isador Snapper who had come to the United States after teaching medicine for a number of years in China. A gifted and widely experienced clinician, he was said to have been insulted when it was suggested that he take the American Boards – and never did. Joe returned to Edmonton in 1950. After successfully passing the examinations of The Royal College for Certification in Internal Medicine he was

appointed to the staff of the University Hospital[10] and given the rank of Sessional Instructor in the Faculty of Medicine in December that year.

As was customary at that time, he also obtained staff privileges at the Royal Alexandra Hospital and consulted at both the Misericordia and General Hospitals. His practice grew rapidly, not only in his referred work because of his reputation as a competent and careful consultant, but also in what was really a family practice among his friends and acquaintances who trusted his ability and appreciated his compassion and sincerity.

As time passed Joe spoke of restricting his practice to referred cases and to cardiology. He managed to do neither completely. He could not refuse to see an old patient or an old friend and it did not matter that they had non-cardiac problems. His enthusiasm for teaching and his loyalty to the University never flagged, and no replacement for him was found after his sudden death from a myocardial infarction on December 9, 1976 while in Calgary to attend a meeting.

Neither Joe Dvorkin nor Gordon Bell had personal experience or skill in invasive procedures but together they urged on Dr. Scott, who was both Dean and Professor and Head of Medicine, the need to establish a cardiac catheterization laboratory. In *Department of Medicine, a Personal View. 1969 - 1974*, I described the events which led to my opportunity to return in July, 1953 to inaugurate this new diagnostic service.

Joe was always willing to take part in the introduction of new methods of diagnosis and treatment. This made him an ideal companion with whom to work when I returned, with limited experience, to introduce new and recognizably dangerous methods of diagnosis to a conservative medical community.

Gordon Bell generally acted as a moderating influence, waiting to be convinced that procedures were truly useful, but once converted he became an enthusiastic user.

Invasive studies using cardiac catheterization were less than 10 years old in 1953. To the original objectives of Cournand, which were to measure intracardiac pressures and cardiac output, had been added the need to identify left-to-right shunts by measuring oxygen saturation and right-to-left shunts by intracardiac injection of radio-opaque material.

Intracardiac dye curves, using Evan's blue, and later Fox green, were developed in the early fifties by Dr. Earl Wood,

10 His appointment was at the same time as those of three surgeons who were to become close professional colleagues of his – Drs. Michalyshyn, McCarten and Willox.

clinical physiologist at the Mayo Clinic. In his expert hands, and in association with Dr. Howard Burchell, dye curves were used to measure cardiac output to identify and quantitate both kinds of shunt. Essential to this technique were the Waters cuvette oximeter and the ear oximeter which was designed and developed in Rochester. The skilful use of dye curves at the Mayo Clinic appeared to delay the use of intracardiac angiocardiography at that centre. The widespread adoption of angiocardiography in most institutions awaited the later introduction of appropriate catheters, pressure injectors, and probably most important of all, rapid changing devices for the radiographs.

In 1952-1953 at the Heart Hospital, University of Minnesota Hospitals in Minneapolis, pressures were measured using the Hamilton manometer, a photographic recording system which was frustratingly difficult to balance and use. This was being replaced about that time by the strain gauge (Statham) and direct recorders (Sanborn) which permitted operators to monitor pressure tracings for catheter positions through an auxiliary oscilloscope.

Radiologic equipment consisted of a fluoroscopic screen and standard table which together resulted in reduced mobility of the catheterizer, his assistant and the patient, particularly in the completely darkened room required for fluoroscopy.

There were no defibrillators generally available to lessen the anxiety which the catheterizer experienced when he heard his assistant announce premature ventricular beats. Cardiac resuscitation, which demanded a thoracotomy, was infrequently attempted except in the operating room where direct cardiac massage was occasionally successful.

In preparing for catheterization in Edmonton equipment was purchased and assembled between July and November, 1953. Dr. H. E. Duggan, Head of the Department of Radiology, agreed to let us use one of the radiologic rooms which was equipped with a table mounted fluoroscopic screen. Radiology was then occupying the ground floor immediately north of the "doctor's entrance" to the now demolished 1913 wing of the University Hospital. This room later became part of the Chaplain's office. It faced west and with no air conditioning and a late afternoon sun it became unbearably hot to work in an operating room gown under which one wore the old and much heavier lead apron, added to which were a mask, cap and red glasses.

Work began at about 4:00 p.m. when all the "regular" radiologic work for the day was finished. Dr. Gerry Copestake, an English trained radiologist was a valued member of the small team consisting of Joe Dvorkin, me, Brian Sproule (first as a resident and then as a Fellow for the year 1954-1955) and Ann Shaw who was seconded to us once a week by Dr. Ted Bell, Director of Clinical Laboratories, to help me with the blood gas estimations.

Equipment was meagre. A tray of instruments was prepared by Central Supply and a thoracotomy set was on standby. Catheters were mounted on plywood boards to maintain the curve at the tip although steam sterilization generally defeated this purpose. Gas sterilization was introduced later. The remaining equipment consisted of a Statham strain gauge, a cuvette oximeter and the associated Waters control unit and galvanometers, and a Sanborn Twin-Viso, which recorded one pressure tracing and an electrocardiogram.

Joe Dvorkin sat before the recorder watching the tracings with a towel over his head to prevent the light from the machine interfering with fluoroscopy. It was his responsibility to identify changes in the pressure tracing as the catheter passed into the various chambers and to warn me of extrasystoles, harbingers of disaster when the only electrical defibrillation I was aware of had been accomplished by Dr. Richard Ebert in Minneapolis in the course of one of their catheterization studies. He had attached two wires to the E.C.G. electrodes and had attempted defibrillation by having an assistant thrust the other ends into the electrical wall outlet. Joe's warning consisted of the word "extra," repeated with increasing urgency for each consecutive premature beat, alarming both me and the patient.

Cardiac output and shunts were calculated by the Fick principle which necessitated collecting expired air in a Douglas bag, taking blood from the femoral artery and obtaining a mixed venous sample from a central site, preferably the pulmonary artery. Ann Shaw and I together did the measurement of oxygen content and saturation on duplicate samples of blood with the requirement that we differ by no more than 0.2 ml/100 ml. This usually meant working in the laboratory until 10 or 11:00 p.m. – or until we ran out of blood.

Before attempting the first catheterization of a patient it had seemed wise to check our equipment out on a dog. We proposed to Dr. Angus McGugan, the Superintendent, that we bring a dog to the hospital to spend an hour or so in the E.C.G. laboratory. Dr. McGugan was an old fashioned Superintendent,

occupying the position which became President in later years. He had never been faced with such an outrageous request but after giving us a heartfelt lecture on the potential hazards of introducing germ-laden animals into his hospital he reluctantly agreed to a brief experiment to test our procedures and equipment in the then E.C.G. lab which was in the basement at the south end of the 1930 wing.

There was little formal training in new techniques 40 years ago and certainly no authoritative body established standards or issued certificates of competence. Both Joe Dvorkin and I, and later Dr. Neil Duncan, "learned on the job." My earlier experience had consisted of spending several sessions in the catheterization laboratory in the spring of 1953 in the Heart Hospital at the University of Minnesota Hospitals, under the direction of Dr. Craig Borden and Dr. Paul Winchell. At that time I was spending a year as a research fellow with Dr. Carleton Chapman,[11] investigating the response to exercise of patients who had recovered from myocardial infarction. Because I had accepted Dr. John Scott's invitation to return to Edmonton to start a catheterization unit it seemed necessary to gain some experience, albeit slight. Joe Dvorkin had less, or perhaps more accurately described, no personal experience. Nevertheless, supported by Gerry Copestake, whose help, ingenuity, skill and knowledge were invaluable, we saw the unit grow to a busy diagnostic service, responsible for both pediatric and adult investigation.

In the third year (1956), with one full-time and one part-time physician and a Fellow, and referrals from a supportive group of internists and pediatricians, we did 89 catheterizations and had by that time introduced selective angiocardiograms.

Joe Dvorkin would have been the first to admit that his skills did not lie in activities involving manual dexterity. Sometimes when the lights were turned on after several minutes of manipulating the catheter there was a tangled mass of limp catheter lying between the cut-down in the patient's arm and the stop-cocks to which the catheter was attached, the result of the one-way twisting to which Joe had submitted the catheter while trying to coax it into the pulmonary artery within the 10 minutes which we were allotted in total radiation time. Nevertheless Joe thoroughly enjoyed the challenge and the drama of the cath lab and continued working there until the responsibilities were reassigned in 1967-68 and the original catheter pushers were spared further radiation.

11 Later, Professor of Cardiology at Southwestern Medical School, Dallas, and Dean of Medicine, Dartmouth Medical College.

Chapter 3

Homes of the Division of Cardiology

When I returned to Edmonton in July, 1953 with a commitment from an American foundation to support me for five years, Dr. Scott arranged that I have an office in the hospital. There was no space provided by the University for any clinical staff, including the Professor and Head of the Department of Medicine at that time, or indeed for the next 16 years until the Clinical Sciences Building opened in 1969. One must remember that there were no clinicians employed as teachers by the University other than the part-time voluntary clinical staff who received honoraria of a few hundred dollars at most, but who taught out of a sense of obligation to the profession.

The University Hospital

My office was an examining room on Station 64 – the obstetrical floor – and I was fortunate to be able to share a secretary with the E.E.G. Laboratory, which was on the floor below. In the absence of dictating equipment I either gave the secretary hand-written material or she took dictation in shorthand. Because she was a recent immigrant from Holland, she used Dutch for her shorthand which was then translated back into English when typed out. Although it was frequently difficult to reconstruct what I had originally said the result was better than trying to type it myself.

The hospital and Medical school accepted the concept of geographic full-time staff (a term which was actually introduced somewhat later) but it was the hospital which generously provided offices, laboratories and even secretarial help, which made possible the expansion of the clinical geographic staff over the first 16 years of this new era.

During these years we grew as we moved, or perhaps more accurately stated, we moved after we grew. From the first office on Station 64, I moved to an office behind the Nurses Station 65, an area vacated by Dr. Don Wilson when he succeeded Dr. J. W. Scott as Professor and Head of the Department of Medicine in 1954.

When Dr. Rossall became the second geographic full-time member of the Division in November, 1957, an office was created for him from part of a passageway diagonally across from Station 65.

The Wells Pavilion

Three more moves took place between 1957 and 1969. The first was in the fall of 1958 when we moved to the South Wing of the Wells Pavilion, a three-storey structure erected north-west of the hospital, built in 1923 for the patients under the Soldier's Re-establishment Program. This had served veterans of both World Wars and I remember it as a student and intern as a place which housed complicated orthopedic problems. It also had served as quarters for house-staff until the House-Staff Residence[12] was opened on 114th Street on July 1, 1958. We had sufficient space on the third floor to establish offices for staff and Fellows, a meeting room/library and a cardiopulmonary blood-gas laboratory.

Our new quarters were heated, more or less, by ancient, rumbling, hissing radiators which sat under the windows which in turn provided air conditioning the year round. The added space was welcome and we sought to increase the professional staff and Dr. Brian Sproule returned in July, 1959 to take over the development of a pulmonary laboratory. We employed two senior and two junior laboratory technicians and the whole floor which had been allotted soon was filled.

The hospital intended that the Wells Pavilion would be temporary quarters for us, to be used until we could move into the planned Clinical Services Wing,[13] which was to house an Ambulatory Care area, the Emergency Department, Clinical Laboratories, Operating Rooms, the Case Rooms for Obstetrics, and the Department of Radiology. Our plans had always envisaged a geographic proximity to Radiology because most of our investigation took place there. Dr. H. E. Duggan, Director of the Department, was supportive of our request for space in his Department and we planned what seemed to be a most adequate area, considering that we were, in addition, going to be permitted to keep much of our space in the South Pavilion.

The plan in Radiology consisted of a radiologic room for catheterization next to which was a laboratory for blood gas analysis, preparation, record keeping and storage. In the radio-

12 In 1985 the House-Staff Residence became a Hostel.

13 This was demolished in March/April, 1987, as part of the MacKenzie Centre building program.

logic facility which we had used from 1953 to 1960, there had been no storage space and we had to remove all our equipment from the room after finishing a case and store it as best we could in the corridors, a chore for technicians and hazardous for our recording devices.

In addition to the work areas, we had offices for Dr. Dick Rossall and me with a shared secretarial space/waiting room and a shared examining room. Dr. Sproule occupied a smaller and less adequate office next door because his needs had not been taken into consideration in the planning which had gone on some time before his return to Edmonton had been arranged.

A great advantage to the move was the ease with which we could consult Dr. Don Hendin, Radiologist, who was now able to devote most of his time to cardiac radiology while the load steadily increased from 212 catheterizations in 1958 to 542 in 1968.

The Clinical Sciences Building and the Proposed Centennial Hospital

The final move occurred in May, 1969 when the Division of Cardiology, with considerable sadness at leaving Radiology, moved into the first "University" space that the clinical faculty had ever occupied – the Clinical Sciences Building.

Plans for this new building had been made with the expectation that a specialty hospital, the Centennial Hospital, would be built in the early seventies to house the rapidly expanding divisions of Cardiothoracic Surgery, Neurosurgery, Neurosciences, Cardiology, Pulmonary Diseases, Nephrology, Organ Transplantation, Intensive Care and Ambulatory Care. Planning for both the Centennial Hospital and the Clinical Sciences Building took place over seven or more years and was described in my story of the Department of Medicine. However, material relating more specifically to the Division would seem appropriate to add in this review.

Requests for space were first made in 1961 when Dean Mackenzie and the hospital administration argued unsuccessfully for the addition of an auditorium for clinical teaching. In August, 1962, the Dean presented a brief to the Campus Planning Committee and to the Board of Governors of the University, outlining the need for space for the faculty. After a proposed renovation of Corbett Hall proved to be too expensive, the concept of a Health Sciences Centre arose and permission to begin planning was received from the government in November, 1965.

Part of such a centre was to be a clinical specialty unit to contain facilities for those activities described above. In 1966, a subcommittee composed of representatives[14] from the Divisions of Cardiology, Pulmonary Diseases and Cardiothoracic Surgery, completed a report on future clinical requirements of the three divisions.

The Divisions of Cardiology and Pulmonary Diseases requested 30 standard beds, based on a calculation of four beds per day per physician with eight to 10 beds being allotted for catheterization admissions. A combined cardio-pulmonary intensive care unit of 16 to 20 beds was planned and two more beds were asked for in a controlled environment room.

The proposed diagnostic facilities consisted of four catheterization rooms[15] with associated pulmonary and cardiac laboratories, and added up to 7,750 sq. ft. The offices and teaching rooms added to the above resulted in a total request of 15,310 sq. ft.

We expressed concern that the Division was functioning largely as a catheterization unit, serving a population of patients with congenital or acquired heart disease. Important as this was, we were aware that we were not providing our house-staff with the opportunity to see the more common problems created by coronary heart disease or hypertension. Requirements for investigation and treatment of these two groups were incorporated into the planning of ward areas. The following quotation from the report was an accurate prediction, "It is probable that the advances in surgical treatment of coronary disease and conceivably organ transplantation or artificial organs, may increase the demands on investigative facilities."

We proposed that patients with hypertensive cardiac disease and coronary artery disease be attracted to a special clinical unit by providing better care through an active, productive clinical research program. Dr. Bill Mahon, a clinical pharmacologist and internist, was instrumental in starting a hypertensive clinic which he ran for a short time before leaving for the University of Toronto. Perhaps it was our failure to add the proposed two full-time or part-time cardiologists to our staff to run such clinics which prevented the development as envisaged, although the advent of coronary artery bypass surgery soon provided us with more than sufficient patients with coronary disease. The complaint of the house-staff and students

14 Committee members were J. C. Callaghan, F. A. Herbert, R. S. Fraser, R. E. Rossall, and B. J. Sproule.

15 Two rooms were for diagnostic investigation and one for each of the two divisions was for research studies.

quickly became one of having to do a history on yet another patient with angina.

In 1965-66 there was little agreement concerning the purpose and organization of a coronary care unit. We agreed that the active intervention required in a general intensive care unit was only intermittently needed in the care of patients with uncomplicated myocardial infarctions. However, we decided that the objectives of intensive care for those few who did require it should be combined with observation and investigation of the majority and that laboratory facilities for blood gas estimations, use of an image intensifier, etc., should adjoin the coronary care unit. The laboratory would serve patients with either coronary or respiratory difficulties. Such was the unified concept that we tried to put forward to the planners.

The proposal was for four coronary care beds. Largely through the enthusiasm of Dr. Russell Taylor, who was concluding a residency in Medicine in 1965, a program for hospital wide resuscitation had been initiated. Following from this it was agreed that survivors of resuscitation should be monitored and that this could best be done in a coronary care unit.

In this proposal arguments were advanced against any repetition of the separation of the catheterization suites from the rest of the cardiac laboratories and offices, and a plea was made for a full-time cardiac radiologist as a member of the team.

The team concept was expanded by Dr. John Callaghan who, in January, 1966, obtained "approval in principle" from the then Minister of Health, Dr. J. Donovan Ross, for a $10 million Western Canada Cardiology Institute which he proposed should occupy one tower of the planned two tower building to be sited next to the University Hospital. As explained in the history of the Department of Medicine, there was insufficient support for this imaginative plan and it was not revived as planning for the Centennial Hospital gained momentum between 1966 and 1970.

The Centennial Hospital itself fell victim to a review of requirements initiated by the newly elected Conservative Government of Peter Lougheed in 1970 and construction was stopped as the site was about to be excavated.

Planning for the Health Sciences Centre/Centennial Hospital consumed much time of the members of the division between 1966 and 1969. From the Planning Coordinator's office and T.R.W., consultants to the hospital, a request remains in my file which reads, "Would you please check the requirement on TIER I to those [sic] you have requested." Planning was often challenging, if only in interpretation.

The administration of the hospital, in the meantime, struggled with a new problem – a deficit of $630,000 in 1967. They sought the help of divisional heads in explaining to the government what they called "unusual elements" within the hospital. They were perhaps referring as much to staff as to services.

By 1967, planning was proceeding concurrently for the Clinical Sciences, or as it was then called, the Clinical Teaching and Research Building, and the Centennial Hospital. The plan of the Division of Cardiology was to provide space for professional staff as well as for technical staff in contiguity with the catheterization laboratories, intensive coronary care unit and wards in the new hospital. Those physicians in the Centennial Hospital space would be largely responsible for patient care; others whose work was predominantly research and teaching were to occupy space and to have laboratories in the Clinical Teaching and Research Building.

Because the Clinical Teaching and Research Building was to be ready for occupancy by 1969, and the Centennial Hospital was not to be finished until, at the earliest, 1971, the division was forced to move all its functions, apart from patient wards, into the Clinical Teaching and Research Building. The catheterization laboratory was also moved to the Clinical Teaching and Research Building while the equipment and space in the Department of Radiology underwent extensive renovation.

Although not ideal, the Clinical Sciences Building, as it officially became known, provided much needed offices, and for the first time, other useful space for such things as phonocardiography and external recordings, a library/meeting/teaching room, a residents' room and laboratory space. We were able to consolidate our activities from the Wells Pavilion and the Department of Radiology, which we left after 10 years of pleasant relationship.

Chapter 4

Special Developments

Cardiac Resuscitation and Coronary Care

Two technical developments led to the initiation of coronary observation or care units: the first was the development of the direct current defibrillator and the second was the introduction of practical methods of continual observation of the electrocardiogram on monitors at the bedside and the central station.

After Kouwenhaven, Jude and Knickerbocker described closed chest massage in 1960 and others recorded their success in the treatment of ventricular fibrillation by closed-chest alternating current defibrillation with an Electrodyne defibrillator in 1956, the justification for opening the chest for cardiac massage rapidly vanished.

The first "crash wagon"[16] was designed by and built for Dr. Callaghan for use in the Division of Thoracic and Cardiovascular Surgery. "Cardiac resuscitation by opening the chest surgically with direct cardiac massage is not only frequently ineffective but usually contraindicated in patients with serious ischemic heart disease."[17] This conclusion, reached by Phillips and Burch, made it easier to move to other ways of treating cardiac arrest.

I have not been able to identify the first resuscitation in which closed chest massage was used at the University Hospital, or when external defibrillation was first used. In September, 1964, Dr. Dvorkin, in a letter to me, drew up a list of recommendations concerning these matters, including the materials to be kept on a special tray for treatment of arrest (intubation equipment, calcium chloride, sodium bicarbonate, Levophed, electrodes and a scalpel) the last-named for "open heart massage, but this should be discouraged at this time."

This comment suggests that the procedure was still being used in 1964. The application of electrodes directly to the

16 A photo of this wagon appears in the 37th (1959) *Annual Report of the University Hospital.*

17 Phillips, J. H., and Burch, G. E. *Amer. Heart J.* 67:275, 1964.

Original Crash Cart, ca 1960

heart had been the practice of the surgeons since the advent of cardiopulmonary bypass. After the introduction of external defibrillation, resuscitation became the practical procedure that we know today.

The earliest manuals describing resuscitation, such as those of the Los Angeles County Heart Association and the Heart Association of Maryland described closed-chest cardiac massage and mouth-to-mouth artificial respiration. At that time (about 1962) external defibrillation was practiced with A.C. current with a recommended two or three shocks of 440 volts lasting 0.25 seconds.

Drs. Gerry Klassen, C. Broadhurst and Arnold Johnson were the first in this country to report their results in attempted resuscitation of 86 patients over an 18-month-period at the Royal Victoria Hospital in Montreal.[18] Ten patients survived to

18 Annual Meeting, Canadian Cardiovascular Society, Quebec City, November 30, 1962.

return home as a result of the progress instituted by this pioneer Canadian group.

In July, 1962 there was no defibrillator with the facility for delivering "timed" shock in the University Hospital.[19] I believe that only A.C. instruments were in use then. My certainty about this arises from the tragic outcome of one of our post-operative catheterization studies. The patient was a 19-year-old man who proved on post-operative study to have a complete repair of a tetralogy of Fallot which had been done by Dr. John Callaghan a year earlier. He developed a tachycardia unresponsive to additional manipulation of the catheter and resistant to treatment with any of the available drugs. The post-operative right bundle branch block made us uncertain whether we were dealing with a ventricular or a supraventricular arrhythmia although Drs. Dvorkin, Sproule and I favoured the latter. Increasing amounts of vasopressor were required to maintain his blood pressure. Eleven hours after the onset of the problem we sought the agreement of Dr. Don Wilson, Head of Medicine, to try an untimed A.C. cardioversion. The patient died of pulmonary edema before we could attempt this somewhat rash treatment.[20]

Dr. Russell Taylor was in his final year of the graduate training program in Internal Medicine in 1964-65. He retained some surgical characteristics acquired in his earlier general practice and he enjoyed procedural activities. He combined this interest with an imagination which permitted him to see what needed to be done to provide better patient care, while freely demonstrating his impatience with administrative channels which slowed the implementation of what he considered to be appropriate new developments.

In December, 1964, he enthusiastically accepted the invitation to visit the Royal Victoria Hospital in Montreal where arrangements had been made through Drs. Maurice McGregor and Dr. John Beck for one of our staff to study their cardiopulmonary resuscitation program.

After his return Dr. Taylor concluded his report by writing that "I have some problem deciding from my rather voluminous notes how much to include." He distilled his observations into six pages and it had the desired effect. Plans for hospital-wide resuscitation progressed rapidly with the support

19 A defibrillator with timed or programmed capability for cardioversion was purchased in 1963 – the same year that pacemakers were first used here.

20 Others had shown that random A.C. shocks frequently converted a tachyarrhythmias to ventricular fibrillation which in turn was often refractory to defibrillation.

of Dr. Snell and Dr. Wilson. At the beginning of February, 1965, Dr. Snell, in a memo to administrative heads, authorized the initiation of a STAT code (111) to alert the resuscitation team to a cardiac arrest.

In April of that year Dr. Snell wrote the Hospitals Division of the Department of Public Health requesting funds to equip each of the three sites, Station 51 (Cardiology), a side-room in the Mewburn Pavilion and the Emergency Department, with monitoring and defibrillation instruments.

Between January and April, 1965 the staff had been successful in resuscitating seven of 15 patients who had suffered cardiac arrests. Dr. Snell stated that 400 graduate nurses had been trained in "recognition of cardiac arrest and in the procedures of mouth-to-mouth respiration and external cardiac massage." As a result of his request to the hospitals division we were able to purchase three Electrodyne D.C. defibrillators – one with pacing capability – and the necessary monitoring scopes.

Dr. Taylor met with the residents in February and by March, 1965 a roster had been drawn up to specify the person responsible at any one time for the conduct of the team at a cardiac arrest. Such was the enthusiasm in the first few months that a limit of eight essential participants was established to reduce overcrowding in the room, and duties for each person were listed, leading to a printed outline for the attending and house-staff.[21]

Russ Taylor recognized the need to centralize the care of patients who were resuscitated on various other wards than cardiology in the hospital. In January, 1965, consideration was given to converting Station 67, the Polio Ward, into a cardiopulmonary centre for acute care. Dr. Lionel McLeod, who had joined Dr. Sproule and me in the initial discussion concerning medical intensive care, decided against including renal patients in such a unit. In May, 1965, Dr. Sproule and I submitted our first brief to Drs. Snell and Wilson in which we attempted to justify an intensive care area which would be served by specially trained nurses and provided with appropriate equipment and laboratory facilities.

It did not prove possible to transfer the polio patients, as had been proposed, to the Aberhart Hospital. It was not until

21 There is also a memo from Miss G. Johnston, Director of Nursing Services, to all charge nurses, dated May 16, 1966, defining the responses required of nurses to an arrest code. Miss Coolidge, Charge Nurse on Station 41, was responsible for both the care and re-stocking of all crash wagons and the training of nurses on her ward.

this was done in 1971 that it was possible to create a general intensive care unit on what had been Station 67, under the direction of Dr. Garner King.

In the meantime less ambitious plans were pursued in order to initiate coronary care.

In March, 1966, in a letter to Dr. Macbeth, Head of the Department of Surgery, Dr. Taylor referred to difficulties in managing patients after resuscitation on surgical wards. On May 9, 1966, a two-bed coronary unit was opened on Station 41 to which cardiology had just moved from Station 51. From this time on victims of cardiac arrest were routinely transferred to Station 41 for observation and monitoring.

Dr. Taylor was appointed in July, 1965 to the new Department of Ambulatory Care, Dr. L. C. Grisdale, Director. However, Dr. Taylor continued to plan and care for patients with acute cardiac problems. In May, 1966 he wrote to Miss Thompson, Associate Director of Nursing Education, to ask that he be allowed to train a small number in each senior class of student nurses in resuscitation, cardiac monitoring and defibrillation. This was the beginning of a program through which cardiovascular nurses were trained for work on surgical and medical acute care cardiovascular wards. In the meantime the hospital sent senior nursing staff to take approved courses in coronary care in other parts of this country and the United States.

Within the limited space of the two-bed coronary care unit, unexpected progress had been made in an important aspect of patient care, namely giving trained nurses more responsibility for diagnosing and treating life-threatening arrhythmias. The Medical Advisory Board, in June, 1966, accepted recommendations arising from a meeting of Miss Purcell, Director of Nursing, Miss Johnston, Director of Nursing Services, Dr. Taylor, Dr. Snell and me. In brief, this new and quite novel policy resulted in training nurses on Station 41 to recognize cardiac arrhythmias and to apply electrical defibrillation when indicated. This was a milestone in the transfer of a number of responsibilities from physicians to nurses which eventually occurred.

Further development of more adequate physical facilities was continually frustrated by the promise of a Health Sciences Centre and then in its place, the Centennial Hospital.[22]

There was understandably reluctance of the Administration and indeed refusal by the Hospitals Division of the

22 Described in some detail in the *History of the Department of Medicine 1969-1974. A Personal View*. Dr. R. S. Fraser.

Government to agree to expensive renovations when a new building was in the planning stage. Nevertheless, the coronary unit managed to increase a little in size and even more in effectiveness as time went by.

The two-bed unit of 1966 was sited in the semi-private room adjacent to the Nursing Station on 41. To overcome the difficulty in providing constant observation, Dr. Taylor borrowed a closed circuit television camera[23] which provided a limited view of one of the coronary patients on a T.V. screen at the nursing station. Dr. Callaghan maintains that the lens of the camera was never returned and the dispute remains to be settled to this day.

The results of resuscitation in the unit were gratifying. In his report of October 26, 1966, Dr. Taylor reviewed the 79 admissions to that date. Thirteen patients were defibrillated and eight survived.

An increasing number of internists – but not all – were willing to have their patients with acute infarctions transferred to cardiology beds where monitoring was available. Some thought that this only placed a patient in a more stressful milieu and those who believed this continued to treat their patients with infarctions on the general medical wards.

It soon became apparent that the procedures for the transfer of patients with infarcts to the unit had to be more specifically set out. We in cardiology observed that the other internists were generally unfamiliar with techniques and equipment in the unit. In addition, the multiplicity of routines resulting from an unnecessarily large number of attending physicians was unsatisfactory for the nurses. From January, 1967 the admitting cardiologist designated for the month became responsible for general supervision of the unit and for care of any patient not specifically transferred to a named cardiologist. This new, and to that time, untried system was accepted by the staff in the Department of Medicine and has remained in force ever since.

Some other proposals did not fare so well. Dr. Taylor kept a steady flow of memos directed to the Director of the Division of Cardiology, the Nursing Office, the Head of Medicine and various members of the administration. In December, 1966 he proposed to Dr. Snell that certain senior nurses in cardiology be trained to start intravenous infusions. In his reply Dr. Snell stated that in strictly legal terms nurses could not carry out this "medical" procedure. He also believed it was inappropriate to overload the already insufficient number of nurses with addi-

23 It cost the E.C.G. Fund slightly more than $1,000 to have this equipment made serviceable. The hospital was unable to help.

tional duties. He added, "Any decision to implement such a change as you have recommended will have to wait until the nursing staffing problem has been resolved."

Five days later Dr. Taylor wrote Dr. Wilson that Dr. Snell had been sympathetic to the proposal and asked him (D.R.W.) to deal with the legal problems so that "in the new year when we commence our intensive care nursing training program we would be legal as far as teaching our candidates how to start intravenouses." The nursing shortage must have been resolved in record time!

Although coronary care nurses and cardiologists now accept all these activities and more as expected skills of nurses in the unit, changes at the start seemed to come about with frustrating slowness. Some of us remember the concern expressed by a senior nursing officer when she witnessed a nurse attaching E.C.G. electrodes to a patient during one of the early cardiac resuscitations. She was not entirely satisfied that the procedure was free of hazard to the patient (or nurse) but perhaps of more distress to her was to learn that a step-by-step description was not yet written up in the Nursing Procedure Manual. At that time the nursing instructions for taking blood pressure extended over almost two printed pages, a masterpiece of thoroughness. Despite their initial conservatism the Nursing Department soon supported their staff in the changed and enlarged concept of their professional activity.

The Coronary Care Unit attracted some of the best nurses who combined enthusiasm and good judgement with a high degree of skill and many excellent ideas for improved care. They, the residents, and the attending staff, truly constituted a team.

In a short time the unit was transferred to a four-bed ward and later a central console was added together with individual bedside monitors. A second four-bed ward became a "step-down" unit with monitoring, although in busy times it served to provide active care for patients after a much abbreviated stay in the unit across the corridor.

In November, 1966 at the annual joint meeting of the Canadian Cardiovascular Society and the Canadian Heart Foundation in Calgary, a symposium on Coronary Care and Shock illustrated the change in medical attitude from passivity to active intervention in the care of patients with myocardial infarction. Dr. Ken Brown from the Toronto General Hospital, a pioneer in North America in coronary care spoke on the purpose of such units. Drs. Maurice McGregor, George Manning and Al Cox gave papers on various aspects of the subject and Russ Taylor spoke on the role of the physician and nurse in resuscitation.

Between 1966 and 1969, Dr. Taylor remained involved in teaching nurses, both from the University Hospital and from smaller centers, and became a member of the Canadian Heart Foundation ad hoc Committee on Intensive Care Programs for Nurses. Some 67 nurses were trained in the coronary care unit in those early days.

The mortality rate for acute myocardial infarction was reduced from 37 percent in 1965 to 15 percent in 1967, at which point it had reached the mortality level of most well-run units.

All members of the unit contributed to the clinical care, planning and development of the coronary care unit during its first three years. Dr. Joe Dvorkin, a popular and busy consultant, had a consistently heavy load and admitted appreciably more patients to the unit than did the rest of us. Despite such differences the unit ran smoothly and part-time/full-time problems never arose.

Dr. Doug Wallace, Executive Director from 1961 to 1965, resigned to become the Chief Administrative Officer of the Toronto General Hospital. He was succeeded by Dr. Bernard Snell, who had been the Assistant Medical Superintendent (1957-1961), first under Dr. Angus McGugan and then with Dr. Wallace. Dr. Snell himself had been preceded by Dr. Crosby Johnston who moved to Calgary. Although each of these men may have thought of us as impatient and perhaps rash young enthusiasts, they and Dr. Wilson, Director of Medicine and Dr. Ewart Duggan, Director of Radiology, were consistently helpful and supportive of our efforts.

Cardiac Catheterization

At first there was little demand for this new and somewhat threatening diagnostic procedure. Most, if not all, diagnostic investigations requested at that time by internists carried no mortality and little morbidity. In contrast this one required unfamiliar invasive techniques and potentially could lead to fatal arrhythmias.

The essential early support came from referrals from Drs. Joe Dvorkin, Gordon Bell, Charles Rich, Frank Elliott, Ted Donald, Alan Gilbert and Ed Kidd at the University Hospital; Ben Wheeler at the Royal Alexandra Hospital, Frank McInnis who was then practising at Camrose, and Rod Chadwick in Red Deer. Drs. Brock Armstrong, Alf Gander, Neil Duncan and Lloyd Grisdale were early contributors to what soon became a major part of our diagnostic work, namely congenital heart disease in children.

Before discussing the development of the catheterization laboratory it would be appropriate to describe the beginning of "Cardiac Rounds." These rounds played an important role in familiarizing the medical staff with the purposes of invasive cardiology and with cardiac surgery as well as encouraging referrals from outside.

The first recorded notes concerning patients presented at rounds were dated November 3, 1953. One was a patient of Dr. Dvorkin's and the second was presented by Dr. Carl Whiteside, both with rheumatic heart disease. A record was kept from the beginning of the patients who were presented and the recommendations which were made. These were initially in the form of dictated summaries but were succeeded by a verbatim account of each participant's comments after we enthusiastically put into use our first piece of recording equipment complete with microphone. It was a wire recorder and posed daunting challenges to the one secretary available to transcribe the proceedings when the wire flew off, as it sometimes did, and lay in a bird-nest tangle at her feet. Although we had the good sense to revert to summaries somewhat later we continued to keep a record of the care presentations and recommendations for over 25 years and the collected records mirror the interesting changes of cardiology over that time.

I do not believe that any other subspecialty rounds were being held in the University Hospital in 1953 because when I proposed starting a weekly meeting in the old "West Classroom," Dr. Scott greeted the suggestion with uneasiness, suggesting in his quiet way that fragmenting medicine might detract from Grand Medical Rounds which were held weekly for the whole department.[24] Despite his concern he did not forbid this new venture and Joe Dvorkin, Gerry Copestake, Gordon Bell and I began holding a weekly meeting on each Wednesday from 0830 to 0930. That cardiac rounds has continued – indeed on the same day – for 34 years must surely establish this subspecialty meeting as the senior one in this or any other city hospital.

In March, 1954, Dr. McGugan passed on for reply an enquiry from Dr. C. B. Moore from Red Deer. In answer to his question about the "Heart Clinic" about which he had apparently heard, I answered in part, "Patients are presented ... to a group of internists and surgeons interested in cardiovascular problems and a consensus of opinion is obtained. There is no

24 The Department of Medicine at that time included not only the conventional interests of Internal Medicine, but also Psychiatry, Pediatrics and Rehabilitation Medicine.

charge for this presentation." The rounds proved to be a reasonable way in those early days to bring interested people together, to share our problems and to familiarize the medical community with our work.

We soon found ourselves charged with a duty which was not altogether pleasant. In October, 1954, Dr. Walter MacKenzie, then Head of Surgery, told the Hospital Board that he and Dr. Gain, Head of Anesthesia, had agreed that all patients booked for cardiovascular surgery would be required to have a pre-operative medical consultation. That this had not been the case before bears testament to the independence of Dr. Whiteside who had been used to carrying out whatever investigation he considered necessary and making his own decision about the patient's suitability for the operation. Now that cardiac catheterization was about to become available, Dr. MacKenzie wanted to ensure that a team approach was introduced and that a satisfactory standard of diagnosis and treatment was attained.

The Head of the Department of Medicine, Dr. Scott, was asked by the Medical Advisory Board to appoint a panel of consultants to "assess all cases being considered for cardiac surgery." Surgeons who were to be informed of the Board's opinion were Drs. Dafoe, Meltzer and Whiteside. At the November meeting of the Board, Dr. Scott proposed that all cases for cardiac catheterization or surgery be seen at Cardiac Rounds and that before surgery a written statement by the cardiac consultant be on the patient's chart. Although we had instituted our rounds in the hope that by sharing our problems, we could improve our diagnostic skills and demonstrate to others our determination to seek the highest quality of care, we were now expected to intervene if patients had not been adequately investigated or if the proposed surgery was not indicated in the opinion of the majority of those who took part in the rounds.

Within the next few months we were informed that the Royal Alexandra Hospital also had made it obligatory that patients scheduled for cardiac surgery at that hospital be seen at the University Hospital Cardiac Rounds and that the proposed treatment by agreed to by those attending rounds.

Although these requirements were a reasonable accompaniment to the new diagnostic aids which had been introduced into the practice of cardiology it was difficult for Dr. Whiteside in particular not to look on the decision of the Medical Advisory Board as an encroachment on his responsibility for determining which of his patients required surgery. He had pioneered cardiac surgery in the city and clearly resented being told what he could or could not do by people he considered to

be his juniors in every respect. This led to a somewhat strained relationship between him and Joe Dvorkin and me which did not entirely resolve before his move to Victoria in August, 1956.

Catheterization Laboratory

The initiation of cardiac catheterization at the University Hospital was described in the first part of this paper. Between 1953 and 1969 significant changes took place in technique, personnel and in the volume of work. It may be of interest to review the reports of the first patients who were catheterized.

A 28-year-old man with pulmonic valvular stenosis, a patient referred to Dr. Dvorkin, was the first person to be catheterized and this was done on November 18, 1953. We were unable to pass a catheter into the pulmonary artery but on the strength of a right ventricular pressure of 141/20 we thought we had reasonable confirmation of the clinical diagnosis of pulmonic stenosis. This man first had a transventricular valvotomy and later the incompletely relieved obstruction was further reduced under direct vision when extracorporeal circulation became available. He is well and active 33 years after his first, and our first, catheterization.

A 9-month-old baby was catheterized in January, 1954 to prove the presence of a patent ductus. She was given rectal pentothal, nitrous oxide and oxygen by Dr. Ted Gain, then Chief of Anesthesia. This form of "sedation" was used on babies and small children until we adopted the intra-muscular injection of the Toronto Sick Childrens' Hospital – a very effective mixture consisting of chlorpromazine, promethazine and meperidine.

There was a steady referral of pediatric patients with congenital heart problems and of the 12 patients catheterized in the first part of 1954, six were children between four and 13 years of age. The adult patients proved to have congenital, rheumatic valvular disease or what was considered to be chronic severe pulmonary disease.

Although only one study a week was booked in 1954 it proved difficult to correlate all the associated functions if the patient was not admitted on the planned day. Upon the request of Dr. Don Wilson and with the support of Dr. McGugan and Dr. MacKenzie, one bed a week was set aside after February 1954[25] for admission of patients who were booked for catheterization. Although this may seem to have been a minor accomplishment

25 Confirmed in a letter from Dr. McGugan to Peggy Price, Chief Admitting Officer on February 18, 1954.

it made a major improvement in the functioning of the unit and established an arrangement which continued and was modified for the increasing numbers as our work increased.

In September, 1955, Dr. McGugan reported that he had arranged through the Minister of Health for a fund of $50,000 per year to be set aside to support the development of special diagnostic services in the University Hospital. For some unexplained reason the minutes of the Hospital Board also record the statement, "The fund will not be publicized." It may be that those involved considered that it was wise to keep the knowledge of this windfall from the other city hospitals. The fund led to the establishment in 1956 of the Special Services Committee with Dr. Ted Bell as Secretary. This source of money proved invaluable in subsequent years for both the purchase of equipment and the support of personnel in the Division of Cardiology as well as for the development of other special diagnostic areas.

Dr. Ted Aaron had been heavily involved in the care of patients with respiratory failure during the poliomyelitis epidemic of 1952-53. He accepted responsibility for the care of some of those with chronic respiratory paralysis and arising out of this he was asked to develop a respiratory laboratory in conjunction with the cardiac unit, as it was then called. The years 1955-56 saw the purchase of a Liston-Becker gas analyzer and the first pulmonary function tests were carried out in May, 1955 by one of the cardiovascular technicians who had this added responsibility until April, 1956 when a second technician was employed to work primarily in the pulmonary laboratory.

As a response to the need for accommodation for patients with chronic poliomyelitis, the Government authorized the University Hospital to build a western addition to the south wing. This was opened in 1957 and provided much needed space for Pediatrics, Cardio- vascular Surgery, Orthopedics, Ophthalmology, Ear, Nose and Throat, Rehabilitation Medicine, Administration and a new cafeteria in addition to the space for the polio patients. The presence of the patients with chronic respiratory polio led to one of the early projects of what was then called the Cardiopulmonary Unit, namely a study of the nature of heart failure which was being recognized as one of the complications of this disease.

By 1956 the catheterization laboratory boasted an Electronics for Medicine multichannel recorder, a polaroid camera and several strain gauges, but no adequate equipment for angiocardiography. Dr. Aaron continued to add to the pulmonary equipment and both diffusion studies and the measurement of pCO_2 became available in 1957.

In 1956 the Hospital calculated that a cardiac catheterization study cost $285.00. The patient was charged $50.00. Sometime late in 1954 a professional fee of $35.00 for the procedure was accepted by the physician sponsored medical insurance plan M.S.I.

Some aspects of invasive investigation were cheap but nevertheless useful. Early in our cath lab experience we introduced the "ether" test[26] about which I had learned from Dr. Dick Rowe who was then at the Toronto Childrens' Hospital. It had been brought there from France by Dr. Peter Vlad, one of the authors of a paper describing it in 1949. This proved to be an accurate and simple way of identifying the site of a right-left shunt. Amounts of 0.05 to 0.2 ml of anesthetic ether, the dose varying with the size of the patient, were ejected rapidly into the central circulation through the catheter. The injection ordinarily produced a cough but when introduced proximal to a right-left shunt it resulted in a prickling and burning sensation around the mouth, nose and forehead. Shunts through a ductus in the presence of pulmonary hypertension, or simply an injection into the descending aorta resulted in similar sensations in the perineum and the feet.

By repetitive injections at appropriate levels the source of the right-left shunt could be identified even in sedated infants whose grimace or squirming were evidence of a "positive" test. Even after the introduction of intracardiac rapid sequence angiocardiograms this test was used to identify the site at which the injection could best be made. It was finally discarded completely when the hospital would no longer tolerate cans of ether in either the O.R. or the Department of Radiology.

Catheterizations increased to four a week and after the first open-heart operation was carried out in September, 1956, included patients who were brought back for post-operative studies. Universal hospital insurance had not yet been introduced and many of these patients could not afford to bear the cost of this added expense. We remain greatly indebted to the Kinsmen Club whose generous support of a Kinsmen Research Bed over a number of years permitted, until the introduction of Provincial Hospital Insurance, the uninterrupted post-operative studies of all patients who had undergone open-heart surgery in those early days. Much was learned which contributed to better care as our experience grew.

26 Our experience was described in an article published in *Circulation*, November, 1961.

The budget for the year April, 1957 to March, 1958 for the Cardiac Unit was presented for the first time to the Special Services Committee for funding. The sum of $27,700 stretched an unusually long way when viewed in retrospect. Some $5,360 was allotted for capital equipment, including an angio injector; with the remaining $22,340 we were able to provide salaries for Dr. Dick Rossall who had arrived in November, 1957, for the contributions of Dr. Joe Dvorkin one full day a week, part-time funding for the cardiac radiologist, for a radiologic technician allotted to us for one day a week, for two full-time laboratory technicians and finally for a Fellow in Cardiology and for one stenographer.

The equipment which appeared on our budget was basic and not a bit sophisticated by the standards of 1986. It consisted of a bicycle ergometer, a pneumotachograph, a spirometer, a gas analyzer, a second ear oximeter, and an intermittent positive pressure breathing machine. The computer had not yet figured in our plans and the "chip," so essential to all modern equipment, had not been developed.

The cardiopulmonary laboratories moved to the Wells Pavilion in the fall of 1958 and we luxuriated in the additional space. In the Department of Radiology a 5-inch image amplifier was installed and a larger one was promised for 1959.

Dr. Brian Sproule returned from Dallas in July, 1959. He had spent a short time in general practice in Eckville before enrolling in the graduate training program in Internal Medicine, later becoming the first "Fellow" in Cardiology. My mentor during my final year in Minneapolis, Dr. Carleton Chapman, had moved to Southwestern University in Dallas as Professor of Cardiology and through this connection Brian and Marnie Sproule found themselves in Texas for four years. Brian not only had a wealth of experience in general medicine but also became involved in research in both pulmonary and cardiac disease. After returning to Edmonton he was supported through the Special Services Committee in the development of a separate Division of Pulmonary Diseases although for some time the Cardiology and Pulmonary Divisions continued to share space, equipment and at least one technician.

In the 12 months reporting period 1958 to 1959, 237 cardiac catheterizations on children and adults were completed. The new Clinical Services Wing was opened in the summer of 1960 and provided Cardiology with office space next to the catheterization laboratories which were equipped with exciting new radiologic equipment. The additional space which had been freed up in the Wells Pavilion was quickly claimed for research.

Cardiac Catheterization Laboratory, February, 1962

During the early years of catheterization, pediatricians had referred infants and children to us adult cardiologists, inexperienced though we were. It was only appropriate that a pediatrician take over this responsibility and we were fortunate that Dr. Neil Duncan had been interested in this aspect of pediatrics since his graduate experience in Chicago where Dr. Potts had established an international reputation as a cardiac surgeon of skill and ingenuity in the treatment of congenital heart disease. Dr. Ken Martin, Professor and Head of Pediatrics, arranged for Dr. Duncan to visit three pediatric cardiac centres – Chicago, Detroit and Toronto. For three months early in 1956 Neil was seconded full-time by his partners at the Baker Clinic to work in the catheterization laboratory and the Division of Cardiology. By 1958 he had established a monthly pediatric Cardiac Clinic and in 1959, Dr. Ken Martin arranged for him to spend the equivalent of half-time at the hospital. Tuesday was set aside as the morning in which children would be catheterized and we adult catheterizers gradually did less of this work. We were pleased in particular to be able to turn over the newborn to someone with requisite knowledge of this age group.

In 1961, we had, for the first time, a defibrillator in the catheterization laboratory. This Electrodyne External defibrillator, costing about $1,600, served not only the lab but the whole Department of Radiology. Fortunately it was not often required.

Mr. Reg Adshead acted as Executive Director of the University Hospital from the retirement of Dr. McGugan until June of 1961, when he resigned to take over responsibility for planning of the Foothills Hospital in Calgary. He was succeeded by Dr. J. Douglas Wallace, a popular family practitioner from Wainwright, who had left practice there to join the Department of Hospitals. Dr. Bernard Snell remained as Medical Superintendent and George Sherwood was the Business Administrator.

Dr. Wallace stated in his 1961 annual report that, "If the University of Alberta Hospital is to fulfill its proper role, we must be prepared to accept higher patient-day costs than might be acceptable in other hospitals."[27] The budget for the hospital was $7,177,900 and there were some 22,000 admissions. In our submission that year we asked for a second defibrillator – a Corbin-Farnsworth direct current model costing $2,500 – to be used in the cath room to supplement the A.C. machine which kept blowing fuses. We also planned for a new Electronics for Medicine multichannel recorder.

There were no formal training programs for cardiopulmonary technicians in Alberta, nor were we aware of any in Canada. We had been fortunate in employing several Dutch immigrants with various backgrounds. Tony Van Kessel had worked in the Dutch Naval Recruiting Services administration before immigrating to Canada where he first found a job as orderly in the University Hospital. After moving to Nuclear Medicine to work under George Tosh he came to the cardiopulmonary laboratory where he played a major part in developing the technical support staff. Across the street from him in Holland lived Peter Van Moll, a machinist who worked for Phillips. When Tony persuaded Peter to come to Canada it was the beginning of a Dutch connection which resulted in a highly visible Dutch component in the cardiopulmonary laboratory for a good many years.

Two of our staff, Tony Van Kessel and Hank Albregt later took leaves of absence to go to University, but continued to work in the cardiopulmonary laboratory during vacations. They

27 At the time of the Annual Report of the University Hospital for 1961, this was $22.01 per day.

each obtained degrees in science and Tony returned as Laboratory Supervisor in 1960 while Hank took over the responsibility for the pulmonary function laboratory in 1961. During those early years our complement of Dutch workers increased despite the observation of one of them that a Dutchman could never work with another Dutchman. Those who joined us in the late fifties and sixties included Peter Van Moll who is currently in charge of the pulmonary laboratory, Curt Voss who is now a practising physician, Kees Kurperschock, and Adrian Van Son who died recently and who was working in one of the other research laboratories.

Tony had become a valuable member of our technical staff and we established with him what proved to be a useful policy of funding trips for our senior technicians and laboratory scientists to visit other centres and to attend appropriate meetings. Unfortunately the contacts which were made on such trips sometimes tempted our best workers to leave for more exciting employment. Such, at any rate, was the result when we sent Tony in 1962 to a series of places: a biomedical symposium in San Diego; a visit to Beckman in Palo Alto to learn about polarography and gas chromatography; and to learn about exercise testing from Dr. Rushmer in Seattle. The diet was too rich. In 1962 both Hank and Tony left for more lucrative jobs in the United States, Hank going to Toledo and Tony to the Exercise Research Laboratory at Stanford University in California.

Before this occurred we had established an on-job training program (1961) to provide new staff with fundamental knowledge in cardiopulmonary physiology and the associated instrumentation. All technicians were encouraged to enroll in evening courses at N.A.I.T. and in addition a series of 50 lectures were given by Hank, Tony, Dr. Brian Sproule, Dr. Dick Rossall and me. This led in time to the recognition that these technicians constituted a special group and they established a provincial organization, the Physiologic Laboratory Technologist Association (incorporated in 1968). They were instrumental in the organization of a national group, the Canadian Physiologic Laboratory Technologist Association in 1969. Alberta led the way through the provincial association in taking responsibility for setting up training programs, examining applicants for competence in this new technologic field and for the exchange of scientific information.

In June, 1963 the first pacemaker was implanted in a patient of Dr. Rossall by Dr. Cecil Couves. Because the early pacemaker implantations were carried out in the x-ray department we became more aware of and concerned about

appropriate sterile technique. In October, 1963, Martha Gossman, R.N., started work in the catheterization laboratory as a technician, having worked as such in London, Ontario, after transferring from the nursing service. We were soon to appreciate our need for nursing skills after Martha exhibited her ability in both nursing and technology. She was joined later by Mrs. Margo McCarthy, R.N.

When we began to employ nurses who did not have experience as cardiopulmonary technicians the Nursing Office of the hospital made it clear that our nurses should report directly to their office. It took some time to establish our authority to run the laboratory as a unit which included our nurses but eventually a satisfactory arrangement was reached.

Radiologic Developments in the Catheterization Laboratory

Our first image intensifier was becoming rapidly outdated and we were particularly interested in a 35 mm camera to replace our 16 mm one. Definition was inadequate and we still had to work in a darkened room. In 1963 I visited the Department of Radiology at the Hotel Dieu in Montreal to see the Picker Saturn equipment with its C arm. My subsequent report to Dr. Duggan, Director of Radiology, I believe hastened our eventual acquisition of much more useful equipment, particularly for adults. The first biplane angiographic equipment was purchased for the renovated catheterization room in 1964.

Dr. Don Hendin joined the Department of Radiology in March, 1960. Don obtained his M.D. from the University of Manitoba and after taking graduate training in Radiology he developed a special interest in cardiovascular radiology. We were fortunate in having a long and unique association with such a competent radiologist and fine colleague. He attended and contributed to all meetings of what we called the Division of Cardiology – as did Dr. Neil Duncan – although the divisional status was unofficial even within the Department of Medicine as far as the specific members were concerned. Perhaps it was because there was a lack of structural formality that the informal but close working relationships were possible.

Dr. Don Hendin, 1963

Dr. Hendin spent much time planning and arguing for the new radiologic equipment from which we benefitted. In a less traditional way he made a more significant contribution because there were few medical centres which were able to boast that the cardiologists and radiologists worked together so congenially and productively, both in the cardiac catheterization laboratory and in the interpretation of results.

Left Heart Catheterization

Left heart studies were sporadic until 1963 when trans-septal catheterizations were started. Prior to this, left heart studies were accomplished through retrograde introduction of the catheter through an arteriotomy. Dr. Morris Friedman, who was a resident on Cardiovascular Surgery, remembers supervising the repair of a brachial artery after a left heart catheterization (R.S.F.) in 1956, but such events were infrequent.

Information concerned the left atrial pressure and left atrial pulse waves was gathered in the early days by trans-bronchial puncture of the left atrium as described by Allison and Linden.[28]

An operative note of Dr. Whiteside's dated June 20, 1955 reads in part,

> "Under topical application of 2% pontocaine solution to the tracheal bronchial tree, a Negus bronchoscope was passed easily down to the carina ... the auricular needle was passed through the bronchoscope down to the point selected on the right side of the carina. This passed through the wall of the bronchus for a distance of approximately 4 cm."

Fortunately for the patients this procedure was superseded by the more tolerable method of trans-septal catheterization of the heart. Perhaps those who never witnessed the trans-bronchial measurement of left atrial pressure should picture what this entailed. The bronchoscope was a rigid metal instrument and the patient was vary much aware of its passage over the often inadequately anesthetized upper airway. By the time the carina was reached the patient lay rigidly on the table, with a hyperextended neck and an expression of apprehension and distress, looking less like a patient undergoing an investigation than an unwilling medical shishkabob.

A good number of patients investigated between 1953 and 1956 suffered from rheumatic valvular heart disease and assessment of the mitral valve both before and after operation often included measurement of the left atrial pressure. In

28 *Circulation*, 7:669 673, 1953.

March, 1956, in a paper I gave to the Edmonton Academy of Medicine my notes indicated that we had used this procedure 30 times by that date.

Gradients across the aortic valve were measured by recording a femoral or brachial tracing and comparing it to the tracing obtained through a needle introduced through the left precordium into the left ventricle. An alternative method of obtaining left atrial pressures consisted of using a needle introduced through the left paraspinous area of the back, as described by Bjork. This was carried out by Dr. John Callaghan on only a few occasions.

The first trans-septal study was done on a patient of Dr. Rossall's in March, 1963, by Dr. Tal Talibi, then resident in cardiology. Dr. Talibi came to us in 1962 from a residency in cardiology in Pittsburg. His English was coloured by his Turkish origin and his medical education in the French language in Switzerland. His unqualified opinions were delivered in rapid bursts and with great certainty. When he came to Edmonton, Tal found we were not yet doing trans-septal studies and in his decisive way he immediately went about remedying this deficiency. During his time with us at the University Hospital he continued to make contributions to our work, particularly in invasive studies in which he was enthusiastic and skilled. He moved to the Royal Alexandra Hospital in 1964 to take charge of their Intensive Care Unit and subsequently developed a popular program of preventive and rehabilitative medicine in the largely privately supported Edmonton Cardiac Institute.

As pointed out earlier the Department of Radiology was both our partner and our landlord. Dr. Ewart Duggan resigned as Director of Radiology in June, 1966, to accept a comparable position in the Foothills Hospital in Calgary. He was succeeded by Dr. Fleming McConnell from Montreal. Perhaps because we had grown up with and in the Department of Radiology and had always had the understanding support of Dr. Duggan we found the change somewhat uncomfortable. Not only cardiology but also some of the emerging subspecialties in radiology were vying for time and space within a department which had reached its limit of expansion. The resulting tensions and uncertainties required solution.

In March, 1967, I wrote Dr. McConnell to advise him of several problems we faced. The development of vascular radiology under the guidance of Dr. Jack Miller, later to become Director of the Department, had encroached on what we considered to be our time and space in Room 5. This had resulted in a reduction from 28 to three post-operative studies in two

consecutive six month periods and we were unable to continue our clinical research effectively.

Our technical staff felt harried and rushed and patients were subjected to inordinate delays, waiting in hospital until a day that catheterization could be rebooked, in place of the time which had been allotted before their admission, and which had become unavailable. We asked for the room for the full five days a week which we believed was originally planned.

We were faced with the familiar difficulty of being unable to improve existing facilities because new buildings were in the offing. After meeting with Dr. John Read, Dr. Bernard Snell and me, Dr. MacKenzie agreed that he would,

> "make a request of the Board of the University of Alberta Hospital that the research catheterization facilities planned for the Clinical Sciences Building be used in part for service purposes on the clear understanding that when further facilities became available in the Centennial Building such service work in the Clinical Sciences Building would cease."[29]

In December, 1967 we once again provided justification for this request to the hospital planners through Mr. Forman, and a room layout and equipment needs were drawn up in January, 1968, followed by a brief to Government in June, 1968. No relief had been obtained to cope with the clinical load by April, 1969, and even those patients being seen for the first time were facing long delays before they were catheterized. The program for studying patients after open-heart surgery had been curtailed to the point where it had become ineffective as a method of quality control.

In May, 1969, Dr. McConnell met with Dr. Snell and me to express his opposition to decentralization of radiologic facilities which would occur as a result of the planned extension to the Clinical Sciences Building. To my puzzlement he also denied that he knew anything of the plans which had been developed by Dr. Hendin, one of his staff, working in conjunction with us. This planning had taken place after we had received the agreement of the Dean and Dr. Snell, and with the approval of the Hospital Long Range Planning Committee, the Hospital Board and the Government.

Dr. Snell refused to consider any major changes and we were grateful for his support in this difficult and unforeseen turn of events. Dr. McConnell did not provide us with the description of the "organizational problems" he feared and the matter did not arise again.

29 Quoted from the minutes of the division of Cardiology monthly meeting, April 15, 1967.

The Administration of the Hospital continued to press Mr. Campbell in the Hospitals Division for a commitment to equip the laboratory in the Clinical Sciences Building which had opened in May, 1969. After Dr. Rossall took over the direction of the Division in July of that year he continued to seek a decision and tenders were finally submitted in January, 1970. The room was opened in early 1971, almost two years behind the expected date. Dr. McConnell became ill in August, 1970, subsequently resigned, and was succeeded by Dr. Jack Miller.

Electrocardiography

Dr. Charles Hurlburt was the official cardiologist of the University Hospital between 1922 and his death in 1944. As such he was also the electrocardiographer. After his death the interpretation of tracings for which he had been responsible for many years was left to those who requested an electrocardiogram or to the consulting internist.

Electrocardiography presented an opportunity in the twenties and thirties to the entrepreneur in medicine. In several centres in Canada E.C.G. laboratories developed as relatively independent services within the hospital and were often controlled by a single physician. Charges for both the technical aspect and the professional fee for the interpretation were high relative to other medical fees and those with what amounted to a diagnostic franchise received an excellent return on their investment.

Dr. R. E. (Ted) Bell, 1962

In those hospitals in which autocratic control was retained over the E.C.G. laboratory it was not too difficult, after the original players relinquished control, to introduce changes through which funds from the interpretive fees could be used to the common good in Divisions of Cardiology and Departments of Medicine.

In the University of Alberta Hospital there was an intervening period of 10 years between the death of Dr. Hurlburt and the institution of cardiology as a subspecialty in the Department of Medicine. The responsibility for the technical aspect of electrocardiograms fell to the Department of Clinical Laboratories to which Dr. R. E. (Ted) Bell had returned as Director, taking over from Dr. J. J. Ower in November, 1949, after returning from post-graduate training in Minneapolis.

As described earlier, the Medical Advisory Board in 1945 had advised the medical staff that each person was responsible for providing or seeking an interpretation for any tracings taken on his patients, and this became an accepted source of income. Both of these decisions, as they related to the control of the laboratory and the charges for interpretation, are important in understanding the sluggishness with which change took place in this field.

The E.C.G. laboratory in 1953 was in the basement at the south end of the "1929 wing." The technician was responsible for doing B.M.R.'s (basal metabolic rate measurements) in addition to E.C.G.'s. The B.M.R.'s continued until about 1956 at which time radioactive iodine studies had become available.

Each internist who read tracings visited the laboratory periodically to write his interpretation on those tracings which had been put into his box. In the Mewburn Pavilion, Dr. Ken Hamilton, Chief of D.V.A. Medicine often recorded the electrocardiograms from his patients with a machine which remained in his examining room. He was also responsible for the interpretations of all tracings taken on veterans in the Mewburn Pavilion.

In 1955 approximately 30 tracings were being taken each day. Some 14 attending staff were entitled to interpret tracings and each appeared at his own convenience at various times of the day making it difficult to arrange a teaching schedule for the house-staff.

Dr. Dvorkin and I wrote Dr. Wilson (April 5, 1955) to propose a rotation of readers, each taking one morning a week. They were to be responsible for interpretations which would be coded and stored for teaching purposes. The resident in cardiology would be expected to provide the initial interpretation. We also proposed that fees for the interpretation be used to establish a departmental fund which could be used to support a Fellow in Medicine, to provide travel funds for members of the Department and to provide an honorarium of $100 per month for each of the readers. Nothing came of these proposals until four years later.

In April, 1959 the department met to consider proposals similar to the ones of 1955. The staff agreed that electrocardiograms could be interpreted by a designated group of readers as a teaching exercises. The interpreted tracing would be sent to the ward or to the doctor's mail box in the case of outpatients. However, they did not accept the suggested change in billing and collection, and continued to submit their accounts to the Hospital which collected the fees on behalf of the physician.

For the next four years "reading sessions" were conducted, Monday through Friday, by Drs. Gordon Bell, Joe Dvorkin, A. M. Edwards, R. Fraser and R. E. Rossall. The resident on the service attended when possible but the patient service on cardiology was busy and because our house-staff usually consisted of no more than a Fellow and a rotating resident it was difficult to establish a consistent program, although it was much improved on the past.

Our efforts to provide teaching for the residents led to a further change in 1963 through which the daily sessions were changed to a more formal, but more practical weekly exercise with the use of an epidioscope. In September, 1963 a committee consisting of Drs. G. Bell, Dvorkin and Fraser which had been appointed by Dr. Wilson to look at the continuing development of cardiology, recommended that administration of the E.C.G. laboratory be transferred from Clinical Laboratories to the Department of Medicine. This was not to come about for another four years.[30]

We also asked permission to search for a physician, trained in electrocardiography to supervise the laboratory, teach and develop vectorcardiography and phonocardiography in addition to electrocardiography. These recommendations were agreed to by the divisional heads in February, 1964 at which time they emphasized their belief that collection of fees for interpretation of E.C.G.'s by the division or department should be instituted but only with the consent of each physician involved. The background of this follows.

In 1958 an Act of the Federal Government (Bill 320) signalled the beginning of the change in medical care in Canada. The Diagnostic and Treatment Services Act allotted responsibility to each hospital for providing – and paying for – the professional interpretation of all diagnostic tests which were carried out in the institution. This had generally been seen across Canada to include reports on x-rays, electrocardiograms and electroencephalo-grams. The effect of this Act was to remove from the physician the right to bill the patient or any other agency than the hospital for the professional interpretation component of any of these diagnostic procedures.

In Saskatchewan matters had progressed even farther. The Government of Premier T. C. Douglas introduced the first provincial Medical Care Insurance Act in 1961. In July, 1962

30 In a memo to Drs. Monckton and Fraser of March, 1967, Dr. R. E. Bell proposed the transfer of administrative responsibility for the E.C.G. and E.E.G. Laboratories to Cardiology and Neurology respectively in the Department of Medicine.

the physicians of Saskatchewan withdrew their services for three weeks in vain protest against what they saw as a threat to their professional right to practice.

It was not until January, 1964 that the Government of Alberta agreed to conform to the requirements of the Federal Act; the Hospitals Division of the Provincial Department of Health notified hospitals in Alberta that they were to assume the cost for professional interpretation of tests carried out in hospital.

In his memo announcing a meeting of the Department of Medicine to discuss the ramifications of this decision Dr. Wilson wrote, "The full implications of this Bill have been in effect in nine of the ten provinces for the past few years but not in Alberta." The Social Credit Government of Premier Manning, although reluctant to conform to all the requirements of the Federal regulations, recognized the practical need for federal funds and cost-sharing to meet the increasing burden of financing hospitals. The divisional heads of the Department of Medicine met on February 25, 1964 and endorsed most of the recommendations of the committee from Cardiology which had been appointed by Dr. Wilson the previous September.

Dr. Douglas Wallace, the Executive Director, provided what he entitled, "Background Information" for distribution before the meeting and observed that "Free thinking prevailed in Alberta." To that date only the technical aspects of the tests had been categorized as hospital services. A series of resolutions dated March 7, 1964 resulted from the meeting and one of these bore witness to the "free thinking" alluded to by Dr. Wallace. It read, "That we recommend rejection of the provision as set out in the Act and bill patients directly for interpretation charges for E.C.G.'s, E.E.G.'s and E.M.G.'s." In an interesting contradiction they also asked that a salaried person be appointed to develop the E.C.G., E.E.G. and E.M.G. laboratories.

In addition to the difficulties created by our two levels of government and the Hospitals Division, problems resulted from interpretation of the fee schedule. Fees for seeing patients in consultation were not considered to include the interpretation of all laboratory tests including E.C.G.'s, E.E.G.'s and E.M.G.'s.

Both of those events led to more discussions with memos and meetings at which emotion dominated realism. On February 29, 1964, the Executive of the Alberta Society of Specialists in Internal Medicine, who saw the control of interpretive fees as interference with private practice and a forerunner of salaried-socialized medicine, met to discuss their

response. Their disapproval of any change in the system was apparent in their conclusion that, "any physician arranging to or agreeing to be hired himself on a salaried or contract basis as E.C.G. interpreter [sic] would incur the disrespect of all members of our Society and probably alienate the whole profession."

The Council of the College of Physicians and Surgeons of Alberta, speaking for the Alberta Division of the Canadian Medical Association, recommended to the Hospitals of Alberta that interpretation of E.C.G.'s, etc., be carried out on a "free choice of readers basis," and two months later in June, 1964, Dr. L. C. Grisdale, President of the Council, announced that the fee schedule had been amended such that the fee for E.C.G. interpretation was specifically included in the fee for any major consultation, in hospital or outside.

Those times when a physician could bill for interpretation of an E.C.G. had been curtailed until it seemed an opportune time to persuade members of the Department of Medicine to agree to pooling fees for interpretation. This was accomplished on a voluntary basis in June, 1964 and the E.C.G. Fund officially began to function in September, 1964.

The Fund was to provide honoraria to readers; to supply a portion of the salary of a full-time nonpractising physician who would be appointed to direct the laboratory; to pay for secretarial help in the laboratory and for research fellows; and finally to purchase appropriate equipment. The success of the plan resulted from the participation of about 80 percent of the attending staff. (Six staff members chose to read their own tracings).

In 1964, Dr. Ted Bell predicted an increase of 50 percent in the workload in the Clinical Laboratories by 1970. To obtain more space he proposed moving E.C.G. and E.E.G. laboratories out of their quarters on the third floor of the Clinical Services Wing. His realistic appraisal was that "these are not units of any special interest to the Laboratory."[31]

The problem was that space was nonexistent at that time and no move was possible until the Clinical Teaching Building opened in 1969 and a home was negotiated with the Faculty of Medicine for the E.C.G. laboratory, the exercise laboratory and the computer which by then was supporting the development of a clinical data base as well as a system for computer assisted interpretation of electrocardiograms.

In May, 1965 the reporting system was modified somewhat through use of photocopies but the residents continued to read with the supervision of rotating staff members.

31 Memo to Dr. Snell, February 4, 1964, from Dr. R. E. Bell.

In 1966 a lab. aide was added to the staff of the E.C.G./E.E.G. laboratories which were jointly under the technical direction of Ray Warren who reported to Dr. Bell. Later in the same year we were pleased to learn that the fee schedule had once again been changed so that the "interpretation of all cardiograms could be charged for whether or not they were ordered in association with consults, visits or daily care." This greatly simplified billing in the laboratory but it also stimulated some of the staff in medicine to reconsider their delegation of the reading and to opt out in order to benefit from the additional professional fees. Fortunately sufficient members of the department and those from other departments who had become accustomed to the new system (under which they no longer had to designate who was to read the tracing) remained in the system to assure its continuation.

During the more than 20 years of its existence, the E.C.G. Fund has made it possible to do many things for which funding would otherwise have been unobtainable, either from health care or educational sources. Members of the Division have been supported during their first year or more while they searched out some more appropriate source of salary; technical and secretarial staff were paid from the Fund; a Fellow in Cardiology was, in most years, supported entirely from the Fund and in recent years a resident as well; tens of thousands of dollars were used to modernize and computerize both record keeping and the interpretation of electrocardiograms.

The objective in each case was to improve either the academic or service program. Some critics suggested that health care dollars should not have been used to support staff or research projects, both having a legitimate call on University funding. They ignored the fact that these dollars had been earned as they were intended to be, for a professional service – the interpretation of electrocardiograms – and that it was after they became the property of the physicians involved that these funds were directed to the E.C.G. Fund for these uses. In other institutions without such trust funds the cost of the E.C.G. professional service was the same as at the University Hospital but the fees remained a personal benefit of the interpreters, as indeed was their right. The Division remains indebted to the staff, both of the Division and from without the Division, who have contributed in this way over the years.

The workload in the E.C.G. lab increased at a remarkable rate and with very little relation to the number of hospital beds, which had remained relatively constant, or to the annual admissions which had increased only 1.3 times (17,813 in 1953

to 23,880 admissions in 1968). Between 1954 and 1968 the annual number of cardiograms taken soared from 2,300 to 14,100, somewhat over five times as many.

In November, 1956 we offered for the first time a two-and-a-half day course in electrocardiography which attracted both family practitioners and some internists. To that date the annual "refresher course" sponsored by the Medical Faculty, the Hospital and the C.M.A. Alberta Division had covered a broad range of subjects. The course in electrocardiography was one of the first to be restricted to a specific topic. Perhaps because the format permitted a good deal of participation by those attending, it proved to be a popular and well attended offering in post-graduate education and continued for a number of years.

In addition to the recording of electrocardiograms by the several aging Sanborn direct writers we were interested in vectorcardiography and phonocardiography,[32] both of which became available with the purchase of an Electronics for Medicine multichannel recorder which superseded our original Sanborn Twin Viso. In 1967, we purchased an Elema Mingograph 34 for $7,600 through the E.C.G. Fund. This produced excellent external recordings in the hands of Dr. Carlos Basualdo who was later joined by Dr. Mant Haraphongse.

Automation and Computerization

Interest in the application of computers to various functions of large hospitals grew rapidly in the early sixties. In September 1964, the University Hospital enrolled in an American computer service which stored and analyzed patient data – Professional Activities Study and Medical Audit Program.

In the Division of Cardiology we began to use a Danish system of punch cards in 1958. We stored diagnostic and catheterization information on all patients seen from 1953 onwards who had congenital heart disease or who had undergone cardiac catheterization or had open-heart surgery. The useful limit of this manual system was reached in 1964 when we passed our 2,000th patient.

In June, 1964 I wrote to Dr. Wilson to request that I be designated the person from the Department of Medicine to become familiar with computer applications to data storage in particular, but also to medicine in general. I suggested that in

32 Phonocardiography had long been an interest of Dr. Charles Rich, who practiced largely at the General Hospital. As an internist interested in Cardiology he relied increasingly on phonocardiograms to compensate a serious impairment of hearing.

the future perhaps electrocardiograms might be "read" by the computer. My plan consisted of taking courses in the University Computing Centre during the winter of 1964-65 and then giving up clinical practice for 12 months beginning July, 1965 in order to work with analysts and programmers in the University to develop a computerized system for storage and retrieval of data on patients from Cardiology. The data collected from the initial 10 years would then be entered into this system.

Dr. Wilson supported this proposal and obtained Dr. MacKenzie's agreement. Although I withdrew from patient care for the year I continued in my teaching and administrative duties and whatever it might have been, this year was not a "sabbatical."

Through help from the Special Services and Research Committee I was able to attend a symposium on October 7-8, 1965 offered by Queen's University in Kingston. Some 150 registrants listened to 13 experts describe computer applications to admission and discharge procedures, accounting, patient care, pharmacy, nursing and handling of data in general. The status of the recent application of computers to the interpretation of electrocardiograms was discussed by Dr. Cesar Caceres of the Heart Disease Control Program in Washington, D.C. and I subsequently had the opportunity to attend two conferences organized by him as this field developed.

Among my recommendations to the Administration was that planning in the Hospital for computer applications should include the use of computer techniques in the interpretation of both electrocardiograms and electroencephalograms and that this should proceed concurrently with computer developments in the Hospital as a whole.

In June, 1966 I was able to attend a five day course put on by I.B.M. Department of Education in White Plains, N.Y. on "Computing for the Cardiologist." I found that I was the only Canadian to join the 26 Americans. Although this course was most useful in teaching me the language of computers and giving me an appreciation of the application of computers to cardiology, I certainly did not emerge as a programmer, nor did I end up with any desire to be one.

It was apparent that we would need to find funds for the development of computer-assisted electrocardiography outside of the Hospital and the University. We were fortunate in finding several generous donors. One of these who came to our assistance at the start was the Edmonton Civic Employees Welfare Chest Fund which made a grant of $7,500 for our initial work in computerization in 1967.

Until 1967 a good deal of manual labour followed the recording of tracings, including cutting, mounting in cardboard folders, recording the interpretation and filing these bulky records. Dr. Stewart Reid, then Chief of Cardiology at the Montreal General Hospital was enthusiastic about the system developed by the Marquette Company of Wisconsin which permitted transmission by hard-wire from the bedside to a central terminal where photographic reproductions of both scalar and vector cardiograms were produced and presented in aperture cards.

This system was purchased by the University Hospital in 1967. In addition to reducing the labour required in the laboratory and in markedly diminishing the requirements for storage space, it also provided a signal which could be stored for off-line computer analysis. It also allowed us to arrange for the well deserved retirement of four single channel Sanborn electrocardiographic machines which had been purchased in 1950, 1953 and 1960.

Computer-Assisted Analysis of Electrocardiograms

Cardiologists and their confrères in the computer world were working in a number of major medical centres in the mid-sixties to apply computer techniques to the measurement and interpretation of this analog signal. Some had chosen to work with the standard 12 lead scalar tracing while others preferred the three vectors leads. Among the latter were Dr. Ralph Smith of Mayo Clinic and Dr. Clyde Hyde, an engineer with I.B.M. in Rochester, Minnesota. Together they developed programs for measurement and interpretation which in 1967 were being used in the Clinic.

I had known Dr. Smith while doing graduate training in Minneapolis and through a continuing personal friendship we were able to obtain a copy of his program to use with an I.B.M. 1800 computer. A preliminary arrangement was made with the Department of Chemical Engineering to batch our work during the night on their 1800, the only one in the University. Unfortunately this did not provide a long-term solution to our need for a computer since their department quickly appreciated the uses to which they could put the 1800. No computer time or help from operators was left over for hitch hikers. Only a few tracings were processed.

In 1969 we exchanged this program for one compatible with the new and much more powerful I.B.M. 360-67 which the University had purchased. It proved over time to be unsatisfactory to batch the tracings which were taken to the computer

centre on tape. However we gained valuable experience in recognizing technical and practical difficulties and in planning for the future.

In that same year Dr. C. W. (Bill) Carry, a patient of Dr. D. R. Wilson, initiated a generous five year program of support of computerization of cardiograms in memory of his wife. Through this fund we were able to employ our first professional help, Don MacFarlane, an electrical engineer. He was later followed by Michael Marriott who was both an electrical engineer and a knowledgeable computer programmer/analyst. After expiration of the Carry Fund in 1972 the E.C.G. Fund of the Division of Cardiology continued to provide a salary for Mike until he left to work for the B.C. Institute of Technology in 1975.

In 1972 with the help of Dr. Don Fenna, Professor of Computer Applications in the Faculty of Medicine, we were successful in an application to the Medical Services Research Foundation and received a grant of $60,000 with which Hewlett-Packard equipment was purchased.

An ECAN-D program of Caceres was used to establish a pilot project with the Wetaskiwin General Hospital in 1973. This ran for two years and both their physicians and their administration were disappointed when it had to be discontinued because of changes in the central University computer hardware and a change to a new interpretive program.[33] During those two years electrocardiograms taken in Wetaskiwin were transmitted by telephone to our computer and the resulting interpretation was printed out on their E.C.G. recording equipment with a verified or corrected interpretation following within 24 hours.

In 1974, the Alberta Hospital Services Commission agreed to fund a computer system dedicated to E.C.G. interpretation and this became operational in 1976. Since that time most of the tracings at the University Hospital have been processed by the Hewlett-Packard system with periodic improvements and changes in hardware relating mainly to collecting and processing.

Cardiac Data Processing

I referred earlier to the manual punch card system on which all patients who had catheterization, who suffered from congenital heart disease or who had "open-heart" surgery were

33 We changed first to the program of the Glasgow Royal Infirmary (Dr. Peter Macfarlane) and finally to the commercial Hewlett-Packard program which is running currently in 1987.

entered. In 1964-65 with the help of I.B.M. and the University Computing Centre, we developed a format for computerizing these data. A catalogue of diagnoses based on one used by Dr. John Keith at the Toronto Childrens' Hospital was expanded to include diseases of adult cardiac patients.

The Alberta Heart Foundation supported this project entitled *Cardiac Data Processing* for three years (1966-1968) with a grant of $26,450. Material abstracted from the clinical files was coded, put on punch cards and stored on tape in COBOL through the University I.B.M.-65 computer. We were greatly helped in our early work by Dr. Don Scott of the Department of Physics who was then Director of the Computing Centre and particularly one of his staff, Al Heyworth, who was responsible for the original COBOL program and its implementation.

Continuing support over the years was obtained from the E.C.G. Fund of the Division of Cardiology and from the Department of Medicine.

From this beginning grew the present Divisional record library and our permanent record librarian. This divisional record library is more detailed, more complete and more accessible than the record collection of the Hospital and provides both inpatient and outpatient records of the practices of all geographic full-time physicians who have ever worked in the Division.

The data bank was transferred from the University to the Divisional computer when both hardware and software became available to us. At that time the University had hastened our efforts to develop an in-house facility by reducing their support of COBOL. Although progress often seemed slow in the past, most objectives have been reached and we now have a system which serves both general and special needs in the storage and retrieval of data in the Division, with ready access through computer terminals.

The story of cardiac data processing cannot be concluded without acknowledgement of the dedication of those who over the years have reviewed thousands of records, puzzled over undecipherable medical writing, coded diagnoses, punched cards and struggled with new programs. Among those to whom we owe our gratitude are: Linda Strand, Heather Sherriff, Susanne Bennett, Maureen Miller, Susan Clarke, Yvonne Wolff, Cathy Tong and Judy Sieben.

Chapter 5

Surgery

Cardiac surgery which preceded the establishment of the Catheterization Unit at the University Hospital was described in Chapter 1. At the University Hospital the only surgeon doing cardiac surgery in 1953 was Dr. Carleton Whiteside, if one excludes the single pericardectomy attributed to Dr. Herb Meltzer, whose work was otherwise largely in the treatment of pulmonary tuberculosis. Tribute is now paid to those who followed.

Dr. Colin Dafoe

In February, 1952, Dr. Colin Dafoe was given an Outdoor appointment in Thoracic Surgery. He had begun his practise in Edmonton in August, 1950 and his first hospital appointment was at the Royal Alexandra Hospital.

Colin was from Ontario. After graduating from Queen's University (1938) he married a classmate, Dr. Charlotte Small, and in the same year they sailed to England where Colin continued his graduate training until he enlisted in the Royal Army Medical Corps in 1940. He had an unusual and distinguished military career, serving in the Middle East (Iraq) and North Africa before parachuting into Yugoslavia where he spent seven months with Tito's partisans as medical, military and political observer for the British. Many years later Charlotte was invited to Yugoslavia to receive for Colin the Order of Service to the People with Silver Wreath, and the Order of Merit for the People with Silver Wreath, awarded but never presented to Colin at the conclusion of the war. His final military posting was to No. 37 Military Mission in Italy.

Following his discharge in February, 1946, he continued his surgical training in Britain. He interrupted this to accept a British Council Fellowship to spend time with Professor Crafoord in Stockholm. It was here that he first learned about Edmonton.

Dr. Whiteside, who had visited Crafoord in 1947, wrote to the Professor to ask him to encourage any interested cardiothoracic surgeons to consider practice in Edmonton. Neither

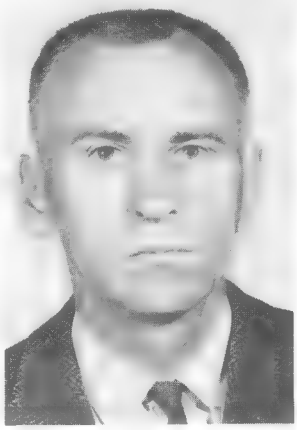
Dr. Dafoe nor his wife knew anything of Alberta or Edmonton but, having no other plans, they arrived here in August, 1950.

Dr. Whiteside had led Colin to believe in correspondence that he was inviting him to join in a partnership. This proved not to be the case although they did for a short time share an office.

Dr. Colin Ross

Dr. Colin Ross joined Dr. Colin Dafoe and as partners they developed a busy practice in thoracic surgery with a somewhat smaller amount of their time devoted to cardiac surgery. The majority of their practice was at the Royal Alexandra Hospital although each had an appointment at the University Hospital.

Colin Ross, a classmate of Dr. Joe Dvorkin, graduated from Alberta in 1943. After service with a paratroop regiment he took graduate training in surgery and thoracic surgery.



Dr. Colin Ross, 1964

Both Dafoe and Ross did valvular surgery and operated occasionally for coarctation of the aorta and patent ductus arteriosus. In October, 1956, Colin Dafoe left to spend four months with Dr. Charles Bailey in Philadelphia, to benefit from Bailey's extensive experience in surgery of the mitral valve.

Colin Ross appeared to be the more interested of the two in extracorporeal circulation. When open-heart operations first began in 1956, Dr. John Callaghan suggested to Dr. Ross that he gain experience in intracardiac surgery by scrubbing with him for 200 consecutive cases. As Dr. Callaghan now remembers, Colin Ross, after scrubbing on several cases, found that it was impossible to avoid conflicts with his bookings in the operating room at the Royal Alexandra Hospital where he and Colin Dafoe were doing an increasing volume of esophageal and pulmonary surgery. Neither Dafoe nor Ross subsequently entered the "open-heart" field. Dafoe practised a decreasing amount of cardiac surgery, having as his main interest trauma of the chest and surgery of the lung and esophagus on which he published some 16 articles. He disappeared while hiking in Waterton Park in July, 1969, and it was not until his body was found in 1972 that this sad event was explained.

Colin Ross contributed his much appreciated surgical skill to the experimental work being done on dogs by Dr. Dick Sherbaniuk and me in 1954-55 in the McEachern Laboratory. (This name was later applied only to the Cancer Research facility while the additional space made available for animal experimentation became known as the Surgical Medical Research Institute). Colin later developed an interest in transplantation of the lung and published results of successful preservation and re-implementation of the canine lung in 1969.[34] Like his partner, he also did progressively less cardiac surgery and at the time of his sudden death from coronary artery disease at age 61 in 1980, he was doing mainly thoracic surgery.

Dr. Carleton Whiteside, Dr. Herbert Meltzer, Dr. Colin Dafoe and Dr. Colin Ross were all doing "closed" valvular heart surgery and congenital heart surgery, with the latter limited almost entirely to ligation of patent ductus, repair of coarctation and some Blalock anastomoses for tetralogy of Fallot, with only infrequent cases of closed valvotomy for pulmonary valvular stenosis.

Dr. Walter Mackenzie saw the exciting opportunities being opened up by intracardiac surgery, first under hypothermia or cross-circulation and finally with the development of extracorporeal circulation. He sought and found a young enthusiastic and well-trained surgeon to initiate the era of "open-heart surgery" in Alberta.

Dr. John Callaghan, O.C.

Dr. Callaghan was a native of Hamilton and a graduate from the Faculty of Medicine of the University of Toronto in 1946. After a short experience in Inuvik, N.W.T., he returned to Toronto to work as a research fellow in the Banting and Best Research Institute and to train in cardiothoracic surgery under the direction of Dr. W. G. (Bill) Bigelow. It was during that time that he and Dr. Bigelow successfully demonstrated that the heart would respond to the transvenous introduction of repetitive electrical impulses to the sinus node, thereby laying the foundation for the development of clinical pacemaking. After spending time with Mr. Russell Brock in London, John went to San Francisco to work with Dr. Frank Gerbode who had established a reputation as a leading cardiac surgeon. It was from California that he came to Edmonton having been persuaded by Dr. Mackenzie that Alberta offered both opportunities and challenges.

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34 *Thorax*, 24:333, 1969.

The saga of cardiovascular surgery at the University of Alberta Hospital has been described by John Callaghan, with his customary flair, in a publication celebrating the 30th anniversary of open-heart surgery at the University Hospital.[35] I will not attempt to add to what has already been written except to describe the interrelationship which developed between our two divisions and the influence which cardiovascular surgery had on the development of cardiology.

Dr. John Callaghan, ca 1960

Cardiology and the Surgeons

Cardiovascular surgery in the sense that we now know it began in September, 1956 with the first "open-heart" operation for pulmonary valvular stenosis. It was fitting that the patient should have been one of Dr. Dvorkin's because Joe was more prepared than most of us to forge ahead into unexplored territory, whether it be in procedures, operations or simply an untried medication. Adventuresome Joe may have been, but his unfailing criterion was that his actions had to be in the best interest of his patient.

The team at the first operation on September 26th, 1956 was a small one: Dr. John Callaghan with Dr. Leslie Willox assisting him; Dr. Morris Friedman and Dr. Eric Elliot who together had been responsible for putting the pump together; Mrs. Anita Wilde, R.N. running the pump; Dr. Ted Gain, then Director of the Department of Anesthesia giving the anesthetic; Dr. Joe Dvorkin and I as cardiologists responsible for monitoring the electrocardiogram, the arterial and venous pressures and oxygen saturations during the operation.

Joe and I continued to play an active part in the operating room during the early years, first at the head of the table and later from a room immediately above after our monitoring equipment had been banished to what was termed the "dome" from which we could look down into the operating room from a circular viewing area immediately above the table, with an intercom to keep us in touch with the main players.

We customarily arrived 30 minutes before the surgeons in order to insert the arterial and venous pressure lines, using polyethylene tubing introduced through "thin-wall" needles into the brachial artery and vein. During the early operations we

35 *30 Years of Open Heart Surgery at the University of Alberta Hospital.*

Dr. E. (Ted) A. Gain, 1962

also became involved with the pump, particularly when foaming blood running over the floor from the original Lillehei bubble oxygenator rapidly threatened the remaining supply of blood and reduced the time remaining for the surgeons to complete their task.

In those early cases, when diagnosis was not as precise as it later became, we also joined John Callaghan in anxious discussion about what should be done when the unexpected turned up.

The post-operative care was relatively primitive. The patient was taken to a converted semi-private room on Station 53 and the nurses, like us, learned on-the-job. For the first few cases Joe and I stayed most of the night – they were done on Wednesdays – making use of the sofas in the lounge close to the station.

Dr. Callaghan described in the commemorative publication the progressive improvement in recovery rooms. After the first six months we moved from Station 53 to a room next to Nursing Station 56 which became the centre for cardiothoracic surgery after the new "Polio Wing" opened in March, 1957. The facilities were further improved and enlarged when the sun parlour off Station 56 was converted to a recovery room and became Station 58 under the direction of June Coleman, R.N.

After Dick Rossall arrived in November, 1957, he, Joe Dvorkin and I rotated the responsibility for the pre- and post-

Cardiac Surgery Recovery Room

Lillehei Bubble Oxygenator, 1956

operative cardiologic care to the patients undergoing open-heart surgery. Although we frequently took care of patients who had been investigated by one of the other two of us, the arrangement worked well and remained in force until our numbers increased with the addition of Dr. Simon Lee and Dr. Russell Taylor, at which time we reverted to caring for our own patients.

By December, 1958, 105 patients had been operated on. At that time we were restricted to one operation a week with one extra permitted per month. Between 1956 and 1963 the majority of patients operated on had congenital heart problems. Patients with rheumatic valvular disease were subjected to open-heart operations only when the problem appeared to require a look at the valve or when a valvuloplasty was planned for mitral regurgitation.[36] John Callaghan had himself developed quite an effective procedure for the treatment of free mitral

36 One of the earliest was a woman of 28 who had bicuspidization of an insufficient aortic valve and dilatation of a stenotic tricuspid valve in 1961. In 1985 at age 52 she was quite well.

regurgitation which he reported in 1963 as "mural leaflet advancement."[37] Results in 16 of these patients were completely satisfactory and it is interesting to read in the current literature that similar types of repair of the mitral valve are once again becoming popular. About the same time the Starr-Edwards prosthetic valve became available and the results of mitral valve replacement in the first five patients operated on at the University Hospital were reported by Dr. Callaghan at the Annual Meeting of the Canadian Cardiovascular Society in Quebec City in the fall of 1962.

In 1965 the surgeons showed an increasing interest in myocardial revascularization which had been repopularized by Dr. Arthur Vineberg at the Royal Victoria Hospital in Montreal through the use of internal mammary artery implants. That year saw an increase to 132 open-heart operations.

An important restriction on the growth of open-heart surgery was the need for large amounts of blood. The matching and procurement of donors and the follow-up of recipients was a task which was conscientiously and tirelessly performed by Dr. Donald Buchanan of the Edmonton Red Cross Blood Transfusion Service.

When John Callaghan began open-heart surgery, Dr. Mackenzie recognized the need for a supportive and skilled assistant. Dr. Willox provided that steadying influence across the table, without which the program might well have faltered in some of the stressful and difficult early stages.

Between 1956 and 1969 two more cardiothoracic surgeons joined the staff of the University Hospital

Dr. Cecil Couves

Dr. Cecil M. Couves,[38] a graduate of the University of Manitoba in 1945, was in general practice in Saskatchewan before he decided to specialize in cardiothoracic surgery. After spending time in Britain and with Dr. Michael DeBakey in the United States he came to the University Hospital as a Fellow in Cardiovascular Surgery in July, 1957. At the conclusion of his Fellowship he joined the division and became their enthusiastic director of graduate training – perhaps better titled their foreign service officers, since the trainees hailed from every corner of the world.

37 The first of these patients had a mitral prosthetic valve inserted on September 8, 1961.

38 Died in January, 1991.

Dr. Couves' interests encompassed cardiac, thoracic and peripheral vascular surgery but in addition he always appeared to retain some residual desire to act as family physician. After spending 17 years in Edmonton he moved to Newfoundland to become Professor and Chairman of the Department of Surgery at Memorial University where he remained until he returned west to retire to Kelowna, B.C.

Dr. C. M. (Cec) Couves, 1966

Dr. Larry Sterns

Dr. L. P. Sterns played the bagpipes, graduated from Queen's University in 1955 and was looking for a place to practice cardiovascular surgery when he and I were introduced in 1965 at the Annual Meeting of the American College of Cardiology in Boston. He had gained much of his surgical experience in cardiac surgery working in Minneapolis with Dr. Walton Lillehei and was a contemporary there of Dr. Christian Barnard who later returned to South Africa to do the world's first heart transplant.

In 1966 Larry moved to Edmonton where he soon began to develop his special interest in pediatric cardiac surgery although he has continued to care for adults as well as children.

It was with these three surgeons (J.C.C., C.M.C., L.P.S.) that we in cardiology had our most intimate and sometimes exasperating professional contact over the first 16 years of our divisional life. In retrospect it is probably fair to attribute most of the success in comradely living to the weekly opportunities to discuss the problems of both the patients and ourselves in our joint open-heart rounds.

I have already written about the weekly Cardiology Rounds at which patients were presented. What I did not point out was that for the most of those early years our surgical confrères were faithful attenders at and contributors to these rounds, as were Dr. Hendin from Radiology, Dr. Duncan from Pediatrics and also our technicians and senior nurses from the cardiology wards. These rounds, however, did not always meet with the approval of the house-staff who wanted "the facts" with which to arm themselves in preparation for examinations of the Royal College. The rounds did, nevertheless, serve as a meeting ground for the attending staff from different disciplines where views could be exchanged and opinions frankly stated

concerning patients who appeared before us. It was a practical method by which we sought out and applied knowledge to the care of patients.

Although patients proposed for surgical treatment had always been considered at cardiac rounds, the unknown or largely uncharted seas of open-heart surgery soon required a specific weekly meeting confined to matters concerning the patient or patients about to be operated on in the coming week and the results of the previous week's work. Another weekly round was therefore initiated with the beginning of open-heart surgery, appropriately called open-heart rounds. In addition to the surgeons, cardiologists and Dr. Hendin, all of whom continued to attend over the years, we were pleased to have for some of those earlier years a presentative from anesthesia – usually Dr. Gain. These meetings also functioned as death and complication rounds and we tried to the best of our combined ability to solve the puzzling problems of post-operative deaths or unsatisfactory results. Not all these problems arose from surgery itself and we were reminded of our responsibility for improving our diagnostic accuracy when the surgeons' findings did not correspond to our pre-operative prediction. Other important discussions arose from the recurring need to improve post-operative care.

Another way in which we tried to apply control over our work was through careful, consistent post-operative examinations. In this we were leaders in this country. We remain indebted to the Kinsmen Club of Edmonton who provided funds for a "research bed" to which we were able to bring for post-operative studies, including cardiac catheterization, almost all of those patients who had open-heart surgery. This information was useful, not only to us in accurately assessing the results of surgery but also to the patient in his future attempts in seeking employment or insurance or in entering or returning to careers in which standards of health had to be met.[39]

39 In one case the post-operative catheterization results were essential in helping a pilot return to flying duties after closure of an atrial septal defect and in a second instance in supporting a young woman's application to enter nursing training after a similar operation.

Chapter 6

Research

In the 1950s the clinical staff of the Faculty of Medicine became increasingly active in clinical and applied research. Several factors were responsible for this heightened interest. Dr. John Scott, as Head of Medicine (1944-54) and as Dean (1948-59), recognized the need for the faculty to move from the status of a professional trade school to that of an academic component of the University – a faculty in which clinician-scientists would practice, teach and do research. He himself had been a close friend and confrère of Dr. Bert Collip, the Head of Biochemistry (1920-28) who, after purifying the first insulin for the use of Drs. Banting and Best, became a distinguished graduate of the Faculty of Medicine of Alberta, completing his degree in medicine while teaching in a basic science department.

Dr. Scott himself was acting Head of Biochemistry in 1928-29. With this background it is understandable that he would play a major part in the development of the graduate training program (Dr. M. R. Marshall, Chairman 1946-61), the establishment of the Medical Research Fund by the Board of Governors of the University of Alberta, the building of the John S. McEachern Cancer Research Laboratory (1952), and the Surgical Medical Research Institute (1961). In a time when gross and microscopic pathology were still considered to be of paramount importance in the training of all specialists, Dr. Scott was encouraging his trainees in internal medicine to spend a year or more in one of the basic sciences such as biochemistry or physiology.

Dr. Walter Mackenzie succeeded Dr. H. H. Hepburn as Head of Surgery in 1951. Through his insistence that the graduate trainees in his department spend a year in experimental surgery, not only did the trainees carry out research projects in the animal laboratory, but his staff also became actively involved as their supervisors.

In addition to these changes which resulted from the formalization of graduate training programs, and because of the influx of trainees following the discharge of many young med-

ical officers at the end of World War II, a fundamental change occurred in the Faculty of Medicine. Geographic full-time clinical positions were established in medicine, surgery and pediatrics. Those coming to G.F.T. positions in medicine usually had some special interest such as the introduction of radioisotopes for diagnosis and treatment, the establishment of a laboratory for invasive cardiology, the setting up of a pulmonary function laboratory or the inauguration of renal dialysis. This in turn led to the opportunity to offer training fellowships in these areas of special interest and out of these activities grew research publications and Masters programs.

It was through this last route that research was initiated in cardiology. Dr. Brian Sproule was the first Fellow (1954-55) and Dr. Richard Sherbaniuk the second (1955-56). Both worked on a project in the McEachern Laboratory designed to examine the sequential mechanism for high output cardiac failure. It was not sophisticated research by today's standards but with the help of Professor Ken Newbound from Physics we put together a system for recording dye curves, using a cuvette oximeter and mirror galvanometer, to measure cardiac output. At that time there was no unit marketed for this purpose. Electronics as we now know it was in its infancy – there were no transistors or printed circuits in our equipment.

Perhaps the most useful lesson we learned was how to apply quality control to such matters as frequency response of our recording systems, critical damping of pressure tracings and other determinants of good investigation which we were able then to apply to the diagnostic investigation of patients.

Dick Sherbaniuk left (with the results of our work) to continue his residency training in internal medicine at the Henry Ford Hospital in Detroit. We had shown that aortocaval fistulas in most cases resulted in simultaneous failure of the left and right ventricles in dogs as measured by end-diastolic pressures. At that time there were no applicable methods for repetitively measuring end diastolic volume, and pressure alone was used as the indicator. Dick submitted a paper based on this work to the Royal College in a contest for young investigators, unfortunately choosing to do so the same year that Dr. Dick Rowe[40] (later to earn world-wide recognition as a pediatric cardiologist and widely read authority) was the recipient of the award.

Unfortunately the busy life as a resident in Detroit and later the demands of establishing a practice in gastroenterology

40 Died in January, 1988.

in Edmonton took precedence over my repeated gentle urgings that he submit the work for publication. I still try to remind him once or twice a year that I am awaiting his response.

Although our publications mostly reflected our increasing clinical experience, the McEachern Laboratory was a hospitable and pleasant place in which to seek answers through animal experiments. Arising out of the clinical use of chlorpromazine were questions about its relative effect on pulmonary and peripheral vascular resistance. This led to a study conducted on dogs by Dr. John McIntyre of the Department of Anesthesia, Dr. Ken Bradshaw, resident in that department, and me. From this work we published results which showed that the differences in the two resistances were dose related.

The McEachern Laboratory had an excellent support staff among whom were Ted Germain, who was invaluable in helping with surgical preparations, and Terry Willey who became a major contributor in two of our projects.[41] Terry was persuaded by Joe Dvorkin to face and overcome some personal problems, to enter University as a mature student (with a family) and finally to graduate in Medicine in 1968.

Terry designed and arranged for the manufacture of a multichambered motor-driven treadmill drum (1964) for small animals which Dr. Brian Sproule and I used in a study on the effect of exercise on the development of myocardial damage in rats fed an atherogenic diet. The interesting conclusion that the exercised animals fared worse than the indolent controls was reported at several meetings but did not stem the growing enthusiasm for physical activity to prevent human coronary disasters as advocated by an increasing number of physicians.

Arising out of this study, and because we were unable to find published standards of a useful kind, grew a study of the electrogram in the normal rat. Dr. Chuck Harley, Terry Willey and I published a tabulation of measurements in 1967.

In the early days of cardiopulmonary bypass we were uncertain what happened to the serum digoxin after the patient had been on the pump. Clinical reports variously suggested that digoxin was mobilized from the tissues, that the serum level went up or that the serum level fell. The surgeons wanted to know whether the post-operative patient should be "redigitalized" or whether there was a rebound in digoxin levels which would indicate the need to stop it before operation. There was

41 Valuable assistance was also provided by two dedicated assistants—Lucy Olekshy and Eileen Klymak.

no readily available assay for serum digoxin and because we were intent on measuring the effective therapeutic level and not serum glycosides we chose to use the acetyl strophanthidin toxicity test on dogs which were submitted to bypass with or without pre-operative digitalization. The published results (1969) supported the belief that there was no increase in digoxin effect present after bypass and also probably no serious loss of drug.

In the 1950s and 1960s two organizations provided forums at which one could present research papers, ranging from preliminary investigations to significant contributions in basic or clinical fields. One was the Western Regional Meeting of the Medical Division of the National Research Council of Canada and the other was the Northwest Society for Clinical Research. The former held annual meetings in the west with contributions from each medical school from Winnipeg through Vancouver. The venue for the last several meetings was the Banff School of Fine Arts. Our confrères from Winnipeg, led by Dr. Joe Doupe, a popular and most competent clinical physiologist, prepared so well on the C.P.R. train ride from Manitoba for the chilling stay in the Rockies that the railway finally threatened to carry them no longer. These were meetings, attended by faculty and young trainees, which combined serious science with relaxation and conviviality. They served an important purpose for a number of years before being discontinued.

The second western organization was the Northwest Society for Clinical Research which initially consisted of members from the medical faculties of the Universities of Oregon, Washington, British Columbia and Alberta to which was added later the University of Calgary. Each of these meetings was an ideal forum at which a fellow or resident could present a paper before an interested, critical and relatively small audience.

Finally in Edmonton, the Collip Research Club, founded by Dr. John Scott and others in 1946, served both basic scientists and clinicians through monthly meetings at which proposed research and work in progress as well as completed projects could be commented on by one's peers.

A Fellow in Cardiology appointed annually, beginning in 1953, was supported through a variety of sources throughout the years. Both Dr. Brian Sproule and Dr. Dick Sherbaniuk were successful in obtaining Fellowships from the Canadian Life Insurance Officers Association. In 1956 the Special Services and Research Committee began providing in-house funds for the introduction of new techniques, hospital based research and for Fellows associated with such activities. Dr. Henry Wilde

(1956-57) was the first recipient, followed by Dr. Bill Beamish (1957-58). Dr. Jim Woods, an experienced practitioner who chose to leave South Africa, was successful in obtaining a Life Insurance Fellowship while spending a year with us to continue is work on the significance of anastomosis in the coronary circulation. After this he moved to Perth, Western Australia where he practiced internal medicine and cardiology.

The Alberta Heart Foundation was incorporated in June, 1957 and soon became a source of funds through the Grant-in-Aid Program – a welcome addition to the National Research Council and the drug companies which had been the only organizations to which we had been able to turn. In addition to the Alberta Heart Foundation the newly formed confederation of provincial Heart Foundations, called at that time the National Heart Foundation, introduced personnel support through scholarships and fellowships.

Summer research projects for medical undergraduate students were supported by the Edmonton Civic Employees Welfare Association for several years. In 1960, for example, three cardiologic studies were financed in this manner for work supervised by Dr. Little (Hematology), Dr. Hendin (Radiology), and Dr. Rossall (Cardiology). A number of years later the Medical Research Council began to support summer student research through grants to the Deans of Medicine.

In June 1960, Brian Sproule and I joined Max Howell and J. F. Alexander of the Physical Education Department in an interdisciplinary study of the effect of the R.C.A.F.-5BX exercise program as measured by treadmill performance. This work was later expanded and we were joined by Ross Macnab and Ron Watson in the study of treadmill performance of participants in various sports. These projects were supported by the Fitness and Amateur Sports Directorate of the Department of National Health and Welfare of Canada. This was the start of physiologic studies on exercise which have continued to be a major interest in the Faculty of Physical Education.

In 1965, Dr. Simon Lee joined the Division, coming to us after a year in Sweden on a Merck, Sharp and Dohme research Fellowship. He quickly set up a long-term project to measure work capacity in patients before and after valvular surgery, supported by a grant of $12,000 from the Alberta Heart Foundation. A study of the physiologic effects of maximal exercise, this one funded by the Department of National Health and Welfare was an extension of his interest in the physiology and pathophysiology of exercise and was carried out on patients who had suffered a myocardial infarction. He also introduced a

graded exercise test for patients with coronary artery disease and studied the hemodynamics of patients given nitroglycerin and others after acute blood volume expansion.

Simon joined Dr. Dick Sherbaniuk in his examination of the hemodynamics of Valium, and Drs. Sproule and Galanti in an attempt to correlate lung scans and pulmonary angiography. He joined Dr. Pat Lynn-Davies and Dr. Sproule in assessing the effect of Oubain on patients with cor pulmonale. In the Surgical Medical Research Laboratory he measured end diastolic ventricular volumes in lambs and studied the effect of propanol in dogs.

Simon Lee was supported as a Fellow by the Canadian Heart Foundation from 1966 to 1970 and contributed significantly to the research and graduate program of the division. Dr. Sung, Alan McClelland and later Dr. Zaragosa were awarded Masters degrees for work carried out under his direction.

Dick Rossall's major interest was in the application of new methods of instruction. However, some time after he came to Edmonton he was successful in obtaining support from the National Research Council which enabled him to conclude work he had begun in Leeds on the pathologic and radiologic characteristics of pulmonary vascular interstitial changes in patients with heart disease.

His interest in a new method of instruction was kindled one Sunday afternoon in 1968 when Dr. Bryan Hudson, an ebullient Australian from Monash University, who was spending a sabbatical leave as the first Muttart Visiting Professor in the MacLaughlin Centre, excited Dick with a description of a patient management problem he had written for the computerized examinations which were being developed in the Centre.

Dick had been worrying about our approaching difficulties in coping with a new curriculum in which "systems" were to be presented to groups of 14 students in eight four-week programs, a total of 560 teaching hours for our two geographic full-time and one part-time staff.

He saw the computer in the Faculty of Education which Bryan was using as a way of presenting material to students in an interactive fashion but, having personal skills as an illustrator, he pictured something more. Together with Wayne Osbaldeston, a programmer-analyst, and Professor Stephen Hunka, Coordinator of Educational Research Services, and with a Grant-in-Aid from the Canadian Heart Foundation, he developed a unique system.

Textual material was combined with audio and visual presentations. This was particularly effective in the teaching of

cardiology in which use could be made of diagrams, electrocardiograms and heart sounds.

Each student was assigned his own computer terminal and had a 16 mm film with 1,000 images on it, controlled through the central processing unit. The diagrams and pictures were projected in association with the text. The student used a light pen to respond to the material on the display screen and instruction was individualized, permitting the student to proceed at his own speed.

The system proved to be a great help to our divisional members who were hard pressed to meet any additional teaching requirements while faced at the same time with increasing service demands and the desire to maintain even a minimal level of clinical research.

The Rossall computerized learning program in cardiology was soon being used, not only by the undergraduate students but also by the residents in medicine and by practitioners returning for refresher courses. Although the program came into use in 1970-71, a year after the date at which this chronical is meant to conclude, this story, like some others already told began before 1969, and has continued up to the present. A translation of the program to permit wider use allowed other centres through the world to take advantage of this novel technique and Dick's contribution has received widespread recognition outside Canada.

During these early years research and development was also made possible through the generosity of Edmontonians. Gladys and Merrill Muttart funded the Muttart chair, through which I was supported in part from 1955 to 1961. In 1969, Dr. C. W. Carry made the first of five annual grants to support the development of computer-assisted interpretation of electrocardiograms, enabling the eventual introduction of a working system.

Between 1953 and 1969 the division grew slowly in professional personnel but much more rapidly in demands for patient care. The classes entering the Faculty of Medicine enlarged and teaching responsibilities increased. We hoped that the appointment of Dr. Simon Lee to a position in which research and teaching would be the main responsibilities would help to remedy the deficiency in the divisional research. Unfortunately, he became involved to a greater degree than had been planned or expected in clinical service. Although he continued with his own research projects a cohesive and expanding divisional research did not result.

Chapter 7

Personnel

In the preceding parts of this history I have described in some detail the contributions of the early participants in both cardiology and cardiovascular surgery. Between 1953 and 1969 others joined Dr. Dvorkin and me. Dr. Gordon Bell relinquished his active appointment to make the Royal Alexandra Hospital his "admitting" hospital and Dr. Charles Rich moved to Victoria where he joined his old colleague, Dr. Carleton Whiteside, in the spring of 1960.

In 1956, I received encouragement from Dr. Wilson in my request for a second geographic full-time person in cardiology. In the fall of 1955 the Minister of Health had notified Dr. Angus McGugan that a Special Services Grant would be made in the next fiscal year to the University Hospital. It was with the hope that this might provide a basic salary for a new appointee that the department advertised for an internist with experience in cardiology.

In November 1957, Dr. Wilson, two friends of the Rossalls' who were living in Edmonton, and I met Dick and Joan Rossall and their two small boys at the old Edmonton Municipal Airport. They had been 36 hours en route from Leeds, England, and their two active sons had enjoyed exercise breaks at Shannon, London, Detroit, Chicago and Minneapolis before arriving on Northwest Orient Airlines on a crisp northern evening. They had been prepared for snow or even a blizzard after being warned by Dr. McGugan in one of his letters that November was climatically a bad time to arrive!

Dr. R. E. Rossall

Dick Rossall graduated M.B., Ch.B. with Honours from the University of Leeds in 1950. After two years in which he served as House Physician in Leeds and then in London at the Brompton Hospital, and at the Post-graduate school at Hammersmith, he served in the Royal Army Medical Corps for two years. He returned to Leeds in 1954 to continue training, first in Radiology and then with emphasis on radio-isotopes and cardiology.

In 1957 he was Senior Registrar in the Professorial Unit at the General Infirmary in Leeds. The number of consultant positions was small in England and there appeared to be no early opportunity to obtain an appointment in his field of interest. The replies he received to an advertisement he placed in the Canadian Medical Association Journal were "not exciting." He had been following the positions advertised in the British Medical Journal and the Lancet and responded to one from the University Hospital. Within eight months he and his family were acclimatizing themselves to a new culture and the stimulating weather of Alberta in November.

Dr. R. E. (Dick) Rossall, 1957

It was exciting for both Joe Dvorkin and me to be joined by a well-trained clinician and we lost no time in introducing him to our catheterization laboratory and the Canadian type of referred clinical practice. 1957 had been a busy year. We did 100 catheterizations, 36 trans-bronchial pressures and a similar number of pressures at operation. John Callaghan was well launched into the "open-heart" program. I was personally busy in planning for the construction of the proposed Clinical Services Wing where we were to have our first designated quarters. I had also been occupied in founding the Alberta Heart Foundation and serving for two years as its first president. In June 1957, I succeeded Dr. John Keith as secretary-treasurer of the Canadian Heart Association, as it was then known.

Dick Rossall came on faith with few firm promises, like most other new staff in those early days. His basic salary was supplied by the Special Services Committee which struck its first budget in 1957, and from which Dick was paid $5,000 annually as the Assistant to the Director of the Catheterization Laboratory (R.S.F.). His other income was earned through consultant practice.

He obtained his Fellowship in Medicine from the Royal College of Physicians and Surgeons in Canada (he already had his M.R.C.P. London). Alberta then had reciprocity with the General Medical Council of Great Britain at that time.

Dick was soon recognized for the clarity and organization of his teaching and was appreciated for the course he put on for residents who were preparing for the Royal College Examinations. Dr. Wilson appointed him Director of Graduate

Training in the Department of Medicine in 1958. He then succeeded Dr. Mark Marshall as Chairman of the Committee on Graduate Training and in the Dean's Office by 1961. By 1963 it was possible to arrange a shared responsibility between the Hospital and the University and Dick was appointed Assistant Professor and awarded tenure. We seemed to be making progress.

For seven years, from 1957 to 1964, Joe Dvorkin, Dick Rossall and I carried out all the cardiac catheterizations, phonocardiograms, pulse tracings and the medical care of patients having "open-heart" surgery. Dr. Neil Duncan began in 1959 to take increasing responsibility for the children, especially the newborn. Although we had generally enjoyed taking care of the children we were relived to turn over the neonates to a pediatrician and eventually the Department of Pediatrics developed a Division of Cardiology which was able to assume the responsibility for all children with heart disease.

During these busy years Dick joined Joe and me in writing a number of clinical papers and case reports. He had stated, when he first joined us, that he had no experience or interest in animal experimentation and during the years devoted his energy and unusual ability to teaching and to administration at all three levels – divisional, departmental and faculty. To his wide range of activities and to a busy consulting practice the Directorship of the Division was added in July, 1969.

Joe Dvorkin, Dick Rossall and I (two geographic full-time appointees and one private practitioner) agreed that we needed a third person with experience which none of us had in the current methods of research. In 1965-66, I suspended my clinical activities for 12 months in order to start a computerized record system in the Division of Cardiology. We saw an opportunity to attract a third person to our staff by using my clinical practice as a temporary source of funds.

Through Dr. Stewart Reid, Chief of Cardiology at the Montreal General Hospital, I learned of Dr. Simon Lee who was spending a year in Stockholm. An enthusiastic mood of expansion had gripped the faculty who were then planning new buildings – a Clinical Teaching and Research Building, a Centennial Hospital and at one point a Health Sciences Centre. Renovation of the catheterization room was completed in February, 1965 and we were equipped with a bi-plane angiographic unit, with a C-arm being promised for the future.

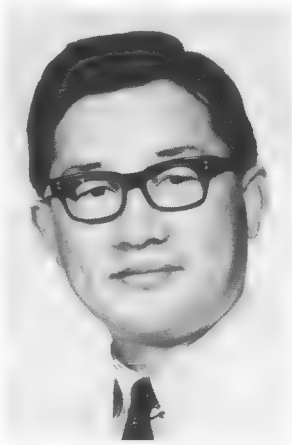
Despite the readiness with which the authorities accepted the need for bricks and beds, there was still reticence about appointing additional geographic full-time staff. Such people

remained a minority on the clinical staff and many of the part-time attending physicians were not convinced that there was a need to add more. In addition, from the practical aspect, there was no ready source of funds apart from outside granting agencies such as the Medical Research Council.

We offered Dr. Lee the opportunity to produce his own salary by taking care of my consulting practice for 12 months. During this introductory year we hoped that he might be successful in an application to a granting agency for a research fellowship.

Dr. S. J. K. Lee

Simon Jong Koo Lee, the son of a South Korean physician, gained his M.D. from Seoul National University in 1957. He came to Canada to intern at the Victoria Hospital, London. Following a year in pathology at Toronto's Mount Sinai, two more years in London, and a residency in medicine at the Montreal General Hospital, he turned to cardiology. He spent two years as a Fellow in Dr. Stewart Reid's Division of Cardiology before leaving for the Karolinska Institute in Stockholm on a Merck, Sharp and Dohme Travelling Fellowship in 1964-65. He had already obtained his Fellowship in Medicine from the Royal College of Physicians and Surgeons of Canada in 1963.



Dr. S. J. K (Simon) Lee, 1968

We were pleased to have Simon agree to join us under this rather bootstrapping arrangement. We hoped that we had been successful in our search for a person who would restrict his activities largely to teaching and research and who would lead other members of the Division in mutual efforts in clinical research. His own interests were in the circulatory adaptation to exercise, on which he had worked in Sweden. In his application to the Life Officers Association for a research fellowship he wrote, "I have a personal ambition to become a leading Canadian investigator and teacher in the future ... and a leader in Canadian academic medicine."

In the same application he realistically described a problem, which we hoped we were in the process of solving, when he added, "In the short time that I have been engaged in the practice of medicine I have found it an impossible task to continue active research and medical practice simultaneously."

We had no source of funds for Simon after June, 1966 when the arrangement for looking after my consulting practice ended. The Department nominated him for both a Life Insurance Officer's Research Fellowship and for a Fellowship of the Canadian Heart Foundation.

The application for the Life Insurance Fellowship obligated the Department to commit itself to a G.F.T. or F.T. position for the recipient at the end of five years of support from the granting agency. When the Dean pointed this requirement out to Dr. Wilson, the latter stated that the Department was not prepared to commit another G.F.T. position to Cardiology and the application never received the necessary approval.

It was ironic that the same situation arose out of the Fellowship from the Heart Foundation which Simon was successful in obtaining, beginning July, 1966. In that instance the Department was able to arrange a progressive increase in University funding and by 1969 was contributing one half of his salary, making it easier to assume the full amount at the end of his term as a Senior Research Fellow of the Foundation. Simon was appointed Assistant Professor in 1967 and full Professor 10 years later.

Dr. Russell Taylor

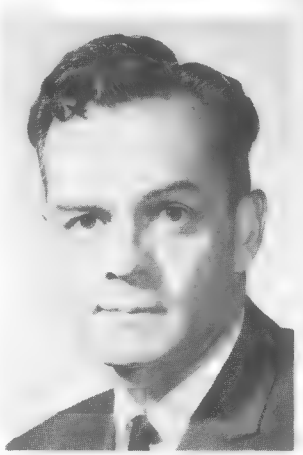
Dr. Taylor[42] would have stayed at McGill in academic medicine if he had not been married and supporting a wife and three children. They returned to Alberta, and after Russ completed a rotating internship at the University of Alberta Hospital, he entered general practice at Devon, a few miles west of Edmonton.

Russell Taylor was brought up on a farm near Delia, a village a little north of Drumheller. As a boy he had always wanted to be a doctor after his mother died during the birth of a younger child. This remained an unattainable goal until he discussed his entitlements with a red-headed officer when he was being discharged from the Royal Canadian Air Force in 1945. When he telephoned his father to say that he planned to take medicine, to his surprise his father advised him to stay in the East and go to McGill, something he had never considered.

His class of "returned men" was given a specially designed program, with courses continuing for 12 months each year. After obtaining an honours degree in Biochemistry he graduated M.D., C.M. in 1950.

42 Died in August, 1988.

Following a year or so in family practice in Devon, Russ moved to Edmonton where he joined the Allin Clinic in 1952, shortly before the poliomyelitis epidemic. His lifelong determination to find answers to medical problems was illustrated by his two-week trip to Minneapolis to learn how to manage respirators which were being shipped to Edmonton to treat the increasing number of people afflicted with respiratory paralysis from polio. The Allin Clinic continued to employ him, both at that time and after his return to Edmonton, where he played a major role in the care of the victims of acute polio at the Royal Alexandra Hospital for the next nine months.



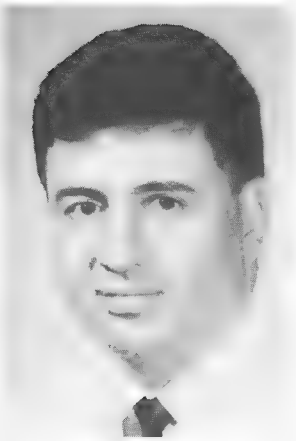
Dr. R. F. (Russ) Taylor, 1967

Joe Dvorkin read electrocardiograms at the Allin Clinic late each afternoon. For over two years he nagged Russ, arguing that he should take graduate training in internal medicine. In 1962, Russ entered the graduate training program at the University of Alberta and in 1965, was appointed to the new-formed Department of Emergency and Outpatient Medicine, directed by Dr. Lloyd Grisdale.

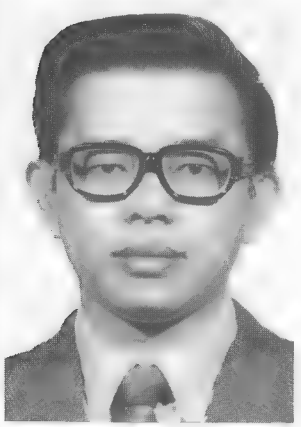
Russ' subsequent career was described earlier – a career characterized by unflagging energy and enthusiasm, a determination to make the best medicine available to the patients and a desire to see all medical students and residents enjoy the challenges and rewards of the practice of medicine as much as he did. His increasing interest in cardiology, particularly in the invasive procedures, resulted in his formal appointment to the Division in 1969.

Dr. Carlos Basualdo

Carlos Basualdo joined the Division as the Resident in Cardiology (E.C.G.) in 1966. He had enquired of us about a residency earlier that year but had been accepted in cardiology at the Toronto Western Hospital. By mid-summer he had forfeited his opportunity to take up that position because of the long delay which resulted when he mistakenly applied for an immigration visa rather than a student one. We were looking for someone to help in the development of computer applications to the E.C.G. system and wrote him about the new position at the time when he was again seeking a residency for the next year. In August 1966, he accepted a Fellowship ($6,000) estab-



Dr. Carlos Basualdo, 1967



Dr. Mant Haraphongse, 1973

lished through the E.C.G. Fund and moved to Edmonton. His duties were to supervise the residents in reading E.C.G.'s and to work with Don MacFarlane, an electrical engineer, who was also supported by the E.C.G. Fund.

Carlos obtained his medical degree from the University of Cordoba, Argentina in 1959. After interning at the Hamilton General Hospital in Ontario where he came with two other classmates, he moved to the United States to take three years in medicine and pathology at the McLaren General Hospital in Flint, Michigan and at Ann Arbor. This was followed by a Fellowship for a year in cardiology at the Rhode Island Hospital in Providence.

Soon after joining us Carlos extended his interests to include external recordings in addition to electrocardiography and for the next decade was responsible, with the later help of Dr. Mant Haraphongse, for the application of apex cardiography, heart sound recording and the study of venous and arterial pulses to the investigation of patients with congenital or with rheumatic heart disease.

He continued for a second year as a Fellow, supported through a grant from the Edmonton Civic Employees Fund, and a third year paid for once more by the E.C.G. Fund.

In 1969 he obtained his F.R.C.P.(C) and we were successful in obtaining the support of Dr. Read and Dr. Wilson for our plan to create a position of supervisor of E.C.G., V.C.G. and External Recordings which was to be paid for from the E.C.G. Fund. The appointment also carried with it the usual teaching and research responsibilities and consulting privileges. Although it was some time before funds from the University budget were obtained for this position we were pleased to have established our fifth "full-time equivalent" position.

Cardiology Associates

By 1966 we had five cardiologists – four adult and one pediatric – and a radiologist working together in a loose organization referred to as the Cardiovascular Unit. Joe Dvorkin had an office in the Medical Arts Building, Neil Duncan was a pediatrician in the Baker Clinic with offices downtown, Dick Rossall, Simon Lee and I were in space provided by the University Hospital and Don Hendin had both his office in the Department of Radiology and a private radiologic facility in the Physicians and Surgeons Building across the street from the Hospital. Russ Taylor did not join the Division until later. Dick, Simon and I used a common patient recording system and all catheterization data from patients of Joe Dvorkin and Neil Duncan were also in the Unit files.

The E.C.G. Fund was established in 1964 and in a sense represented our first effort to benefit from a practice plan. I strongly believed that we should have a similar plan for the catheterization laboratory, and in a letter of January, 1967 to the other cardiologists I described what appeared to be the advantages of collecting all fees in the name of the group and restricting the responsibility for catheterization to two adult and one pediatric cardiologist.

They agreed to the proposal and in my letter to Dr. Wilson I commented that, " ... no one person would have a financial interest in the number of catheterizations done." This had become of some importance after the fee for a right heart catheterization study was increased from the original $35 to the 1967 fee of $75.

Matters moved rapidly ahead with Dr. Wilson's approval and on April 19, 1967 the first meeting of Cardiology Associates was held with those present being Duncan, Dvorkin, Fraser, Lee, Rossall, and R. W. (Bob) Stewart, the Business Manager of Baker Management who shortly after became the Business Manager of the Associates. The Partnership Agreement and the Deed of Partnership were signed and the new arrangement took effect at the beginning of July, 1966.

There were other advantages to this arrangement of limited group practice in addition to that of preventing the potential abuse of a system which favoured those doing procedural work.

By designating the major interests and activity of each person in the Division we hoped for more consistency in the technical standards and the earlier introduction and appropriate evaluation of new methods of investigation. This applied particularly to invasive investigation but we agreed that the

principle of having a personal area of major interest would include the other activities such as electrocardiography, external recordings, coronary care and other functions as they were identified.

Not only did the pooling from two of these – catheterization through Cardiology Associates and electrocardiography through the E.C.G. Fund – help to reduce the inherent competitiveness of clinical work but it also made available significant amounts of money which over the years were spent to support research and development and teaching for which no other source would have been available.

It is greatly to the credit of our two part-time colleagues, Joe Dvorkin and Neil Duncan, that such a scheme, combining as it did the diverse needs and interests of part-time and geographic full-time members came into being and adapted to changing times for the next 20 years.

In March, 1969 we concluded negotiations with Dr. Glen Friesen, a graduate of U.B.C. who trained in invasive cardiology in Portland, Oregon. He joined us in August, 1969 as the second adult "catheterizer."

Dr. Simon Lee, who had been a member of Cardiology Associates since its inception, wrote the other members in April, 1969 to propose the dissolution of the partnership and the substitution of an arrangement which would have restricted benefits to those who did the invasive procedures, with direct relationship between the income and the number of procedures done by each person. He suggested that a small amount of money be left in the account to support research and service in the catheterization laboratory. Such an arrangement would have separated one part of cardiology from the remainder and would have defeated our intention of unifying the Division and equalizing the rewards for the contributions of members working in areas for which fee schedules were disparate. Furthermore, the understanding with Simon Lee at the time of his appointment in 1966 had been that he would make research and teaching his major responsibilities and spend minimal time in patient care. He had been designated one of the persons to work in the catheterization laboratory largely because of his long-term research interests in pre- and post-operative evaluation of work capacity. Such studies made his presence in the lab necessary during the investigation of his own patients and also those of the rest of us who were entering our patients into the study.

His change in emphasis and goals were unacceptable to the other Associates and his resignation from the Associates was accepted. As Dick Rossall took over the Directorship of the

Cardiovascular Unit in July, 1969 the collegial spirit which had formerly existed seemed somewhat dampened. Simon was allotted a half-day a week for his own studies and continued to work independently of the rest of the Associates until he moved to the Royal Alexandra Hospital in 1980 to take responsibility for the Division of Cardiology at that institution. Cardiology Associates[43] survived this temporary difficulty, still serves its original purpose as of 1987 and is one of the oldest group practice plans in the faculty.

43 Terminated early in 1989.

Epilogue

This collection of facts, observations and, where stated, personal opinion, embraces a period in the development of cardiology which will not be repeated. Not only has science now attained much more importance in medicine but the public has also changed. The "consumer," as the patient seems to have become, is better informed, has greater expectations and is generally impatient when the promised methods of prevention are ineffective and cures are not forthcoming. By the end of the sixties the public had become entitled to almost unlimited medical care, sponsored by governments and comprehensive in nature.

Through their spokesmen (or spokespersons?) in the social sciences, through a rapidly developing industry of health services administration and as a result of the actions of various organized groups, the public has evidenced its determination to become part of the medical care system – a system in which they had been largely passive and grateful recipients in earlier days.

These influences have changed both the practice of medicine and the attitudes of the health professions and the consumers. Between the end of World War II and 1969, medicine was becoming more structured; specialties and subspecialties were being defined by examination and controlled through hospital privileges.

The opportunity to be a medical pioneer still exists and doubtless always will but pioneering will be possible only within the constraints imposed by the public as well as by the administrators and governments, concerned as they are over the increasing proportion of budget demanded by health care. In addition, the physician or scientist must now comply with the decisions of the ethicists and follow the advice of legal advisors, both of whom have become players in a game with new rules.

This is not to suggest that the medical profession and the researchers of earlier days were less ethical or less responsible than their successors. The difference was that restraints were largely self-imposed in earlier times and ideas could be transformed into action without waiting for approval from a number of authorities.

Change occurs because a majority of us see it as desirable. The need for change, the direction and nature of future courses can be better appreciated if we have some awareness of where we have come from. To remind those who were there and to enlighten those who were not, this account has been produced.

Appendices

Appendix A

Fellows and Residents
1953 to 1969 - An Incomplete Listing

1953-54	Brian Sproule
1954-55	Richard Sherbaniuk
1955-56	Henry Wilde
1956-57	Henry Wilde
1957-58	William Beamish
1958-59	David Irving, James D. Woods
1959-60	C. Valle-Cavero D. Amies, R. Eidem, G. Watkins, C. E. McDonnell
1960-61	C. Valle-Cavero William Black, D. Wallace
1961-62	Don Macauley William Black, George Goldsand, Henry Shewchuk
1962-63	T. Talibi T. Nett, V. Sartor, R. Shea, A. Stewart, M. Willans
1963-64	T. Braun, J. Holmes, A. M. Leacock, J. B. Martin, T. Nett, A. Stewart, M.Willans
1964-65	C. Scerrano J. Godel, A. Grebneff, B. Reuther, R. F. Taylor
1965-66	Yee-Kung Sung (Research Fellow) M. Davidman, D. Hasinoff, Pat Lynne-Davies, M. MacMillan, A. F. Wilson
1966-67	C. Basualdo (E.C.G. Fellow), A. Zaragosa B. Caplan, M. Davidman, Wm. Grisdale, E. Phillipson, Schubert, C. Ritzel
1968-69	C. Basualdo (E.C.G. Fellow), A. Zaragosa, C. H. Harley, M. Haraphongse

Appendix B

Publications by or with the Resident Staff

1. **Wilde, Henry**. "Functional" Electrocardiographic Abnormalities. *New England J. Med.* 258:735, 1958.

2. **Wilde, Henry,** Fraser, R. S. Paroxysmal Supraventricular Tachycardia with Congestive Failure in Infancy. *Acta Card.* 14:532, 1959.

3. Venvenutra, R., **Serrato, M.,** Callaghan, J. C., Fraser, R. S. Stenosi subaortico da idiopatica del miocardio: Una nuova sindrome. *Minerva med.* 52:1, 1961.

4. Fraser, R. S., Dvorkin, J., Rossall, R. E., **Eidem, R.** Left Superior Vena Cava. A Review of Associated Congenital Heart Lesions, Catheterization Data and Roentgenologic Findings. *Am. J. Med.* 6:1094, 1960.

5. Fraser, R. S., Rossall, R. E., Dvorkin, J. **Valle-Cavero, C.** The Identification of Right-to-Left Shunts in the Central Circulation by the Injection of Ether. *Circulation* 24:1224, 1961.

6. Fraser, R. S., Rossall, R. E., **Black, W.,** Dvorkin, J. Serum Transaminase Response to Cardiac Surgery Using Cardiopulmonary Bypass. *J. Thoracic & Cardiovas. Surg.* 43:810, 1962.

7. **McDonnell, C. E.,** Fraser, R. S. QT and T Wave Amplitude After Induced Ventricular Premature Beats. *Am. Heart J.* 62:260, 1961.

8. Fraser, R. S., **Macauley, W. D.,** Rossall, R. E. Arrhythmias Induced During Cardiac Catheterization. *Am. Heart J.* 64:439, 1962.

9. **Sartor, V.,** Fraser, R. S. ABO Blood Groups in Patients with Congenital and Rheumatic Valvular Heart Disease. *C.M.A.J.* 90 (4):28, 1964.

10. Fraser, R. S., **Sartor, V.** Mitral Valvotomy During Pregnancy. *Alberta Med. Bull.* November, 1963.

11. **Willey, T.,** Fraser, R. S., Sproule, B. J. A Multichambered Motor-Driven Treadmill Drum for Small Animals. *J. Appl. Physiol.* 19:1186, 1964.

12. Fraser, R. S., **Willey, T.** The Effect of Cardiopulmonary Bypass on Digitalis Tolerance in Dogs. *Acta Cardiol.* 24:184, 1969.

13. Fraser, R. S., **Waddell, J.** Systemic Embolization Following Aortic Valve Replacement. *J. Thoracic & Cardiovas. Surg.* 54:81, 1967.

14. Fraser, R. S., **Harley, C. H., Willey, T.** The Electrocardiogram in the Normal Rat: A Statistical Study from 100 Wistar Rats. *J. Appl. Physiol.* 23:401, 1967.

15. Fraser, R. S., **Wolff, N. E.,** Duncan, N. F. Isolated Ventricular Septal Defect: A Review of 329 Cases. *C.M.A.J.* 100:931, 1969.

Appendix C

Laboratory Staff

M. Arbo
Hank Albregt
Gwen Bailey, R.N.
Robert Burns
Janet Borys
Karen (Jonson) Cannon
Martha Gossman, R.N.
Jack DeJong
Tony Van Kessell
Kees Kurperschock
Roy Lynch
Margo McCarthy, R.N.
Martha McLaren
Paul LaMarre
Alan McClellan
G. Meheriuk
Peter Van Moll
Keith Moore
Erica Pfitzner
Roger St. Helen
Ann Shaw
Adrian Van Son
Tennesse Verenka
Curt Vos

Appendix D

Reminiscences of Mrs. Anita Wilde Cardiovascular Unit Pump Nurse Technician August 1956-58

During my time as pump technician-nurse (August 1956-July 1958) about 60-80 scheduled bypasses on humans were done. The set-up illustrated in picture #1 of the enclosed paper on Open Heart Surgery Using Total Cardiopulmonary Bypass was used exclusively during that time. Initial trials done in the dog lab ("I have to perfect my technique" Dr. Callaghan) required the pump unit to be moved by a pick-up truck between hospital and lab. Tense moments were spent when the unit was needed for set-up at the hospital and Dr. Elliot buried in his research had forgotten to arrange transport. Predictably, on arrival the pump unit was crusted with dried dog blood and hair. The same was true for Dr. Callaghan's special instruments which often had to be bent back into shape before wrapping. With additional funds available, we managed to convince "the team" (Drs. Callaghan, Elliot, Friedman) to have a separate set-up for the dog lab. There was ongoing tension between Dr. Elliot and myself over use of supplies for the dog lab.

Bypass set-up required up to six hours of work prior to sterilization. Plastic tubing of different internal diameter and overall length had to be cut off bulk supplies; the proper stainless steel connectors had to be placed correctly on one end, and both ends had to be capped with 2 x 2's and autoclave tape. Details in handling and assembly had to be developed. Plastic tubing is not flexible. To slip on the connectors, wetting of the tubing ends would make the job easier. This I found out one day by accidentally depositing tears of frustration onto my thumbs which inadvertently transferred the liquid to the tubing ends. Tubing had to remain transparent and maintain original length and diameter after sterilization. This could only be accomplished by use of the steam sterilization technique requiring prolonged venting to evacuate moisture. Only during night hours did the O.R. have enough space and time to follow these instructions. Discolored or cloudy tubing made visualization of air bubbles in the arterial lines impossible. Over 30 packages of tubing of different length and diameter were part of the set-up. Approximately 36 connectors with different internal diameters and openings on either side had to be placed correctly on each line. There was as little as $^1/_8$ inch difference in the connector openings on either end and using the wrong size or reversing ends could result in a leak or "blow-out" during bypass due to high pressure in the lines (increased pressures existed close to pump heads and decreased pressure close to patient). I had been instrumental in one "blow-out" during

perfusion of a dog in the lab prior to the first bypass on a patient. Blood was all over the ceiling, the lines empty and so was the dog. All of us were covered with blood and I can still remember the pink haze obscuring my vision, the hours of cleanup and most of all the ever present fear of repeating this mistake. We devised a storage board for the connectors to size and categorize them correctly after bypass clean-up and again prior to assembly. There was no way of numbering these finely tooled, high polished connectors. We also established a pump room on Station 55 as a place to prepare for bypass, to order and store supplies including special surgical instruments and drugs used during bypass as well as storage of the teaching materials. The latter included heart preparations in individual jars of those unfortunate patients who did not survive the ordeal. The rows of hearts grew and when I mentioned this alarming fact to Dr. Callaghan he said proudly, "But look at the repairs: I did a marvellous job!" What could I say?

Vascular surgery began around 1957(?) and we used woven TEFLON grafts as well as moulded, knitted ones of different diameter and length. They were also available in bifurcations of different sizes. Again sterilization technique was a big problem. On overheating they turned brown and brittle. The pump was used for perfusion with nitrogen mustard in malignancies and Dr. C. Couves was mainly connected with this project. A few Hufnagel aortic valves were part of our inventory and one male patient complained bitterly when he gained enough consciousness to notice the constant "click" which was part of his life from then on. Preparing another set-up while looking at the "pickled hearts" on the shelf above me, I found his objection totally unreasonable. Fortunately, he had no idea how close he had come to be the donor of one more specimen. I truly resented the trips to the morgue for collection of specimens. Prepared specimens served as teaching material to demonstrate congenital cardiac defects and subsequent options for repair. To my mind it was a sign of inadequate teamwork and avoidable miscalculations if the patient did not survive the first 48 hours. We had relatively few cases which did not make it off the pump. The problem was in the post-op care as knowledge of electrolytes was in its infancy and especially their relationship to perfusion rates which we could not adjust upward to adequately perfuse a larger adult. My husband as a Fellow in Cardiology at that time often took over the post-op care during the first 12 hours and I would make him personally responsible for the patient's survival. We had long arguments. I knew he had done all there was to be done but I was sure there had to be a better way. There were never any doubts in my mind about Dr. Callaghan's surgical competence. The said events were overcome by his ongoing drive, the positive results and his euphoric statements, "But I did a marvellous job!" I was intimately involved in the set-up of the Cardiac Recovery Room (today we would call it I.C.U.). Selection of nurses and equipment was part of my contribution and decisions weighed heavily as I was incapable of allowing for man or material

inadequacies. Having a two-year old daughter and at the end of the year period being an expectant mother again, I only saw life versus death – never the change in quality of life the children were opting for.

Atrial and ventricular septal defects had to be repaired with a nylon sponge patch. There was a surgical stainless steel press to prepare these patches with. The nylon sponge was applied with a 5-8" cube from which I had to cut even slices of 1 cm thickness. These were soaked in normal saline overnight and placed into the press which consisted of two square plates with screws and wingnuts on each corner. The importance of applying equal turns to all screws was brought home to me after producing a "thick and thin." Successful pressing to 50-mm thickness could only be accomplished by pressing wet sponge. Dry sponge did not meld. Sterilization of patch had to be done in the press and the high heat of the steel tended to make the sponge brittle and hard to sew into place. We only had one press. Unwrapping the sterilized sponge was always a tense moment. The heart was open, all was go; what would I do if the sponge was not usable? Luckily, parts could be used every time.

The three bypass pumps required special oil. It took some time to establish the level of oil needed in the pump heads to keep them from overheating during the long hours of bypass. However, too much oil would result in the pumps "coughing up" oil which would deposit on the $^1/_2$ inch rubber tubing along the fingers in each pump head. This would result in reduced volume due to uneven "strokes" produced by slipping of the oil spattered tubing.

Picture #1 in the paper on Open Heart Surgery has a mistake in it. There was only one line delivering oxygen to the venous blood. The line originated at the oxygen filter and entered the vertical venous chamber through a hole in the rubber stopper.

Inadequate venous return would result in inadequate arterial flow. The groan, "speed up perfusion!" would produce a sinking feeling on the part of the technical staff. I used to scan the floor under the operating table to calculate the irretrievable loss. In revisiting my old working place 23 years later (September, 1981), I spent some time with the pump technician during bypass. The modern pumps have little resemblance to the ones I used to operate yet the principle is the same. Someone at the operating table mentioned inadequate venous return and I automatically stooped down to check underneath the drapes. Reflex reaction?

The many pumps, positive pressure breathing device and other machines in the Cardiac Recovery Room needed constant attention for optimum performance. I was the only nurse carrying wrench, screwdrivers and hemostats in my uniform pockets rather than pens, scissors and stethoscope. The positive pressure breathing machine was an automated demand cycling Bennet valve apparatus. It was equipped with a thin rubber diaphragm which regulated the cycling mechanism. It was prone to tears and collection of sticky deposits which necessitated frequent replacements. Partial

disassembly of the wall mounted machine (see illustration in paper) was time consuming. As long as new machines came with specifications I was in business.

Every patient leaving the hospital walking meant victory for the team. Drs. Fraser, Dvorkin and Rossall on the medical side supplied the pre-operative diagnostic work-up as well as invaluable support during the tense hours of bypass and post-operative care. Neither one seemed to suffer from the ever recurring sense of euphoria followed by depression. Their presence instilled in us confidence and a feeling of security. Dr. Elliot was assigned the task of overall technical director. However, his heart seemed to have been lost in the dog lab. In those days he was also plagued by constant epigastric distress resulting in a never ending "windy" condition. Silent, tense moments in the operating room reverberated with the sounds of flatulence. Before anyone could say something, he was already back in the dog lab.

Fond recollections of those existing years outweigh the sad ones. For a nurse it was an unusual assignment. Would I do it again? Of course!

Anita Wilde
Bangkok, Thailand
September, 1981

Subject Index

Index of Personal Names

No subspeciality in medicine has changed more over the years covered by this history than cardiology – the study and treatment of heart disease as it has developed at the University of Alberta. Bob Fraser's account of the accomplishments of the pioneers and those who followed makes fascinating reading and revives many memories and recollections of friends, some of whom are no longer with us, and of procedures, some of which (thank heaven) are no longer performed!

"...a pulsating discoloured mass was visible medial to the right sterno-clavicular junction. Fifty-five feet of wire was introduced into the aneurysm in April, 1951 and he was readmitted in August for another 84 feet! His postoperative blood loss was considerable and he died nine days later..."

"...Joe's warning consisted of the words 'extra' repeated with increasing urgency for each consecutive premature beat, alarming both me and the patient...."

"...our new quarters were heated, more or less, by ancient, rumbling, hissing radiators which sat under the windows which in turn provided air conditioning year round..."

Dr. Fraser has made a major contribution to the recording of medical history as it has developed in Alberta in this well-researched and never dull book. We are in his debt.

—R.E.R.

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